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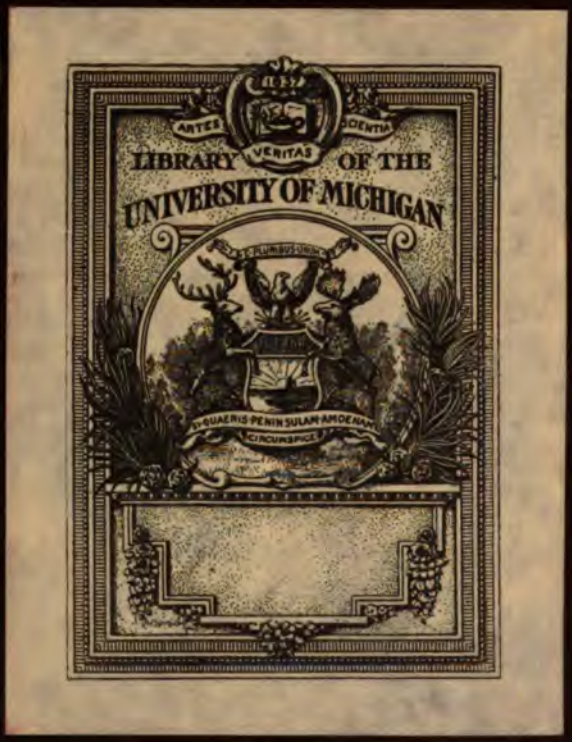
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THE FEDERATION OF INSURANCE INSTITUTES
OF GREAT BRITAIN AND IRELAND.

JOURNAL

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OF

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Dr. **FOR TWELVE MONTHS ENDING DECEMBER 31st, 1900.** **Cr.**

To Balance from last Account				£80	4	4	By Journals—		
,, Journals—							Printing Volume II.	£187 2 10	
Sales, Institutes	£162	15	4				Repurchased Copies Volume I. ...	0 14 0	
,, C. & E. Layton & Co.	13	14	10						£187 16 10
,, Sundries	17	4	1				,, Examinations—		
				193	14	3	Hire of Rooms, &c.	£6 13 0	
,, Examination—							Printing and Stationery	37 13 9	
171 Entrance Fees, 1900 Examination				33	7	6	Postages and Petty Cash	4 4 7	
,, Contributions—									48 11 4
From Insurance Companies	£114	12	0				,, General Expenses—		
From Insurance Institutes	40	17	0				Secretary's Salary	£30 0 0	
				155	9	0	Secretary's Allowance for Office Expenses	15 0 0	
,, Bank Interest				2	2	9	Secretary's Expenses to Bristol Conference	4 6 0	
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							Printing and Stationery	6 17 0	
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									75 13 0
							,, Balance in Bank		152 16 8
				£464	17	10			£464 17 10

Manchester June 7, 1901.

Examined and found correct.

H. D. CURNICK,
T. BRAND MILLER, } *Auditors.*

THE

FEDERATION OF INSURANCE INSTITUTES

OF

GREAT BRITAIN AND IRELAND.

BIRMINGHAM INSURANCE INSTITUTE.

Founded 1887.

Objects: (1st) The reading of papers and delivering of lectures by members, or experts who are not members, upon subjects connected with Insurance business generally. (2nd) The discussion of all questions relating to such business. (3rd) The promotion of social intercourse amongst members of the profession in Birmingham and district.

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Established 1881.

Objects: (1st) The promotion of the study of the principles of Fire and Life Assurance, and of Assurance against other contingencies. (2nd) The consideration of all subjects to which the doctrines of probabilities may be applied, as well as the best methods of collecting and applying statistics. (3rd) The consideration of questions bearing on social science or political economy. (4th) The formation of a library of professional works for the use of members.

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INSURANCE INSTITUTE OF IRELAND, DUBLIN.

Founded 1885.

Objects: (1st) The promotion of the study of the principles of Fire and Life Assurance, and of Assurance against other contingencies. (2nd) The consideration of all subjects to which the doctrine of probabilities may be applied, as well as the best methods of collecting and applying statistics. (3rd) An organisation for any purpose necessary for the requirements of the profession. (4th) The promotion of a good understanding amongst the members of the Insurance profession in Ireland.

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Founded 1886.

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Established 1898.

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THE

FEDERATION OF INSURANCE INSTITUTES

OF

GREAT BRITAIN AND IRELAND.

THE Fifth Annual Conference was held at the Windsor Hotel, Glasgow, on Friday, June 14, 1901, on the invitation of the Insurance and Actuarial Society of Glasgow. Mr. David L. Laidlaw (North British and Mercantile), the President of the Federation, occupied the chair, and there were present:—

EX-PRESIDENT: S. G. Moxey (*Prudential*), Bristol.

HON. TREASURER: Thomas A. Bentley (*London and Lancashire*), Manchester.

HON. SECRETARY to the Examiners: J. B. Roberts (*Sun*), Leeds.

HON. SECRETARY to the Insurance and Actuarial Society of Glasgow: Henry G. Andrewes (*Scottish Union & National*).

SECRETARY: Charles Stevenson, Manchester; and the following delegates:—

BIRMINGHAM: Charles D. Butler (*Royal Exchange*), President; A. J. Lewis (*Sun*), Vice-President; A. E. Patrick (*Patriotic*), Hon. Secretary.

BRISTOL: A. D. Brookes (*Alliance*), Past President.

GLASGOW: N. B. Gunn, F.F.A., F.I.A. (Manager and Actuary, *Scottish Amicable*), President; Adam K. Rodger (Manager, *Scottish Temperance Life*).

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MANCHESTER (Institute): James Ostler (*Northern*); Robert M'Connell (*Royal*); T. B. Miller (Guardian).

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After the adoption of the minutes of last Conference the Report of the Executive was read as follows:—

REPORT 1900–1.

The past year is again a record of steady progress.

The third volume of the Journal was issued in January, and the papers contained in it are well up to the average of those in the previous volumes. The accounts of the Federation are now published in this volume, also a list of the successful competitors at the examinations. The increasing demand for the Journal is the best evidence of its value. Volume I., of which 1500 were issued, is now out of print. and many applications for it have had to be refused. Of Volume II. there are only 101 copies on hand out of 1500 printed. 1700 copies of Volume III. were printed, and all but 440 are already disposed of.

The other branch of the educational work of the Federation has engaged the special attention of the Executive during the past year. A special sub-committee, on which each of the Federated Institutes is represented, was formed at a meeting of the Executive held on 13th December last to consider Mr. Boss's Examination scheme, and to report to the Conference. The work of this Committee has been thorough, and it is hoped that the scheme to be submitted in their report may mark the starting-point for a further advance in this important branch of the work. The number

of candidates for examination this year was 147, as compared with 171 in 1900, and 129 in 1899.

The increasing interest taken by chief Offices of the various insurance companies in the Educational work of the Federation is a great encouragement to the Executive, who take this opportunity to thank the Offices which have so liberally assisted the Federation by subscribing to the funds, and also those Managers who have given the benefit of their ripe experience to the Executive on matters of importance.

One pleasing feature of the past year has been the affiliation of two Colonial Insurance Institutes—Toronto and Montreal—with the Federation on terms arranged by last year's Conference. This appreciation by our Colonial friends is most gratifying.

The Orphanage scheme has been advanced a stage, and it is expected that in a short time it will be duly registered under the Companies Acts.

The President's address to the Conference was as follows:—

GENTLEMEN,—The right to occupy this chair is a distinguished honour which I make no claim to deserve, but the kindly promise of hearty support, so freely given on my election a year ago, secured my acquiescence, as well as my heartfelt thanks for the unanimity with which my nomination was accepted. Whilst claiming your generous indulgence, permit me, in the first place, to say that it gives me genuine pleasure, in the name of the Insurance men of Glasgow, to extend to the esteemed delegates from other centres a most cordial welcome to the ancient and renowned City of St. Mungo. Glasgow, apart from its position as the second city of the Empire, has not a few attractions for the visitor, but at the present moment Time's relentless finger forbids their enumeration. Suffice it to say that for this season our International Exhibition alone will amply repay all the attention which the most ardent delegate can bestow upon it—after the cares of Conference have given place to the well-earned hours of ease and relaxation. I deem it

fortunate, gentlemen, that a lengthy and elaborate address is not expected of your President. In the early stages of our history as a Federation a restriction in this respect was, and still is, not only wise but probably essential. We have at our meetings such a superabundance of practical business to dispose of that a lengthy disquisition from the chair would of necessity crowd out more important interests. When our Federation is well established, when our plans are more fully matured and in the smoothest working order, the day may arise when the address of your President may become as important a feature of the Federation Conference as the annual Presidential address of the Institute of Actuaries is to that distinguished body—but that day is not yet. One notices with satisfaction that good progress is being made with the work of the Federation on the lines so skilfully laid down at the first Conference. The definition and limits of our sphere of influence then agreed upon have been carefully observed, and the requisite loyalty to the dominant bodies who possess the guiding influence in the administration of Insurance business has been fully maintained. It is evident that the work of the Federation is becoming an important factor in the technical education of many in the rank and file of our Fire and Life institutions, and as such it supplies a deficiency which had long been acknowledged by all grades of Insurance officials. The Federation is undoubtedly making a valuable contribution towards a more systematic training in Insurance knowledge and practice, and confers a distinct advantage, not only on the individual who wins its certificates, but also on the institutions in whose employ the certificate-holders exercise their calling. No Insurance official can pass successfully a series of the examinations presented by the Federation without receiving himself immense educational benefit in the way of higher equipment in what specially pertains to his business. The systematic knowledge thus acquired, while strengthening his mental capacity, must make his everyday work more interesting and attractive, and he is bound to perform it more intelligently and with a wider and more

accurate knowledge of its scope and utility. The benefit achieved by these examinations is thus mutually shared alike by the individual competitors and their respective Offices. It is satisfactory to know that Chief Offices appreciate the results referred to, and I think we may confidently expect that the financial encouragement graciously shown to the Federation by many of the Head Offices during the past three years will continue to expand as the advantages which are being derived from the improving educational status of their clerks and officials become more apparent. The successful students, at least, should have no cause to regret their labours, as they can scarcely fail through their certificated skill and enhanced powers to obtain deserved promotion as vacancies arise. I take it that the Federation, by its series of examinations, aims at reducing the knowledge and practice of Insurance business—particularly that of the Fire department—to a well-recognised and teachable science, and in so doing it tends to advance the status and dignity of the calling as a profession. This is a laudable and lofty purpose, and can only be successfully accomplished by the steady and helpful co-operation of the various Institutes, and with the encouraging approval of the Head Office managers. Our system of examinations hitherto has mainly had to do with sections of Fire and Life business, and possibly has not had sufficient coherence as a complete whole. This, however, was scarcely avoidable in the early stages of such a scheme, as the best methods, and the most suitable sequence as to subjects, had to be disclosed gradually by the search-light of experience. In November last Mr. Boss, of the Newcastle Institute, directed attention to the more assailable points in our present system of examinations, and suggested that a final goal should be aimed at, which might be attained by three examinations—the preliminary, the intermediate, and the final—as in the case of the Institute of Actuaries and other bodies. In the following month your executive appointed a special Sub-committee to consider this proposal. The report and result of its deliberations will be submitted at to-day's Conference. I shall not anticipate this report, or your finding thereanent, further than

to say that the Sub-committee, while not proposing to go the full length suggested by Mr. Boss, recommend the adoption of a comprehensive scheme of classification, by which three technical examinations might be made in each branch of Insurance business—Fire, Life, and Accident—and separate certificates awarded for passes and honours in each. The subject is one of great moment and worthy of our best skill There is a finality about the new proposals which must commend them to the earnest student who is desirous of reaching a definite goal, and whose best efforts and training might be steadily directed to the end in view. Should the proposed readjustment of the examinations secure your approval, the scheme may have widespread effects, and prove a productive factor in the advancement and development of our calling as a recognised profession. This is very much to be desired, and has all along been one of the main objects of our existence as a Federation. The admission, by affiliation with the Federation, of two Colonial Institutes, since last Conference, is a welcome addition to our constituency, and matter for congratulation. Perhaps I may be allowed to suggest that these Institutes might be invited to contribute a paper or papers for insertion in a forthcoming volume of our Journal. The third volume of the Journal has been well received, and has been favourably reviewed by the Insurance press. It is widely admitted that the three volumes contain many valuable papers and form a most useful and instructive addition to current Insurance literature. Had the Federation done nothing else than secure the publication of these volumes, it would have earned the lasting gratitude of the majority of the Insurance officials, not only of this country, but also of many Insurance men in our Colonies and the United States, who have expressed their appreciation of the contributions already published. The United States has now a valuable Insurance literature of its own, and as a knowledge of a considerable portion of it, especially of that bearing upon Fire business, is almost indispensable to the technical equipment of the well-read Insurance expert, it is worthy of consideration whether we should not endeavour to make

arrangements for an occasional contribution from American sources being included from time to time in our annual volumes. As originally proposed, the education scheme was intended to include "certificates for essays relating to Insurance business and cognate subjects." This proposal has not yet been given effect to, but it might be worth considering whether, in supplement to the education scheme, a prize might be awarded for the best essay on a subject of current interest, to be chosen annually by the Conference. In any case, in order that our calling may have the fullest opportunities of making progress as a science, it seems to me that it would not only be proper, but beneficial, if the Federation would invite papers on subjects connected with our business which seem to demand improvement in practice, owing to unsuccessful results, or to admitted inconsistencies or anomalies in present methods, brought to light under current working arrangements. So far as I am aware, there is no reason to believe that Insurance managers would disapprove of suggestions on such subjects, if made by experts of experience who had thoroughly considered the points under discussion—care being taken that the suggestions were put forward with due regard to established difficulties, and with due respect to the esteemed opinions of higher authorities. Personally I do not think that the seal of silence should be imposed by the Federation on such topics, as I am convinced that it is only by a full and exhaustive interchange of thought and experience that genuine progress can be made in developing the science of our business on fair and equitable lines, both as regards the interests of the general public and the interests of Insurance as a whole. Of course I am well aware that the views of the Federation and its Institutes in all such matters are bound to be purely academic, as we do not claim as a body any administrative function in the actual conduct of the business. At the same time, the academic view, if soundly and forcibly stated, has its legitimate uses and influence in moulding future decisions and progress; and the Federation, it appears to me, should endeavour to exercise that influence with a wise discretion. It is stated on excellent authority

that some of the brightest underwriting talent in the United States Fire business is to be found in the local offices of the larger cities, and I believe the same remark applies to some extent to this country. Why should the Insurance world not have the benefit of the insight and experience of such men on points with which they are specially conversant? In the Fire business, for instance, we might have suggestions for dealing effectively with the "exposure hazard" in the congested districts of our large cities—a most difficult question, but one of vital importance, whose solution is being anxiously looked for in many quarters; or why should we not have a paper on the advantages of the co-insurance clause as a needful remedy for under-insurance? Accurate rating can only be maintained by the adoption of some method which secures a proper proportion of insurance to value, and, as under-insurance is fast becoming a clamant evil in our business, it must be conceded that every encouragement ought to be given towards taking the necessary steps to eradicate this disturbing element from the problem of fire rating. Then there is the vexed question of fireproof buildings and fire-resisting floors. Serious fires within recent years in buildings claiming that character, involving the destruction or collapse of mills and warehouses, have revealed the fact that the existing rules and practice of the Insurance Offices in regard to such structures are in need of revision. Matured suggestions in the direction of an improved construction, or of a new standard of construction, applicable to mills and warehouses which under ordinary circumstances may fairly claim to be "fire resisting," would be useful and educational and might prove of real value when the time comes—probably soon—for introducing progressive regulations on the subject. In this connection I would invite the attention of Fire Insurance men to the publications and work of the British Fire Prevention Committee. This Committee is carrying out a most serviceable programme, which, if steadily pursued, may ultimately achieve excellent results. A paper on some of the more important tests of the Committee would serve a good purpose, and would probably stimulate an intelligent interest in the subject. Another interesting and

instructive series of Fire papers might be sought for, on the *Non-paying Classes of Fire Hazards.* For example, there is the burning question of metal-working risks, which are at present being underwritten both in England and Scotland at rates of premium far below cost price. The various sections of the metal-working industries form large and important classes of risk in both countries, and for years the business, instead of yielding any profit, has resulted in heavy loss. A paper directing attention to the unprofitable character of the risks from actual statistics, and making suggestions for their adequate rating, would be opportune and serviceable. I am glad to see that two thoroughly practical papers, on sections of the risks in question, have been contributed by the Birmingham Institute, but further contributions on other branches of these trades, or on the risks as a whole, would appear to be necessary, with a view to disclosing more fully the serious consequences which must arise from a continuance of the present indiscriminate competition for hazards of this class. The same remarks unfortunately apply, with almost equal force, to the heavier classes of wood-working risks (in Scotland at least, if not in England). It is unfortunate that there is so often such a lack of co-operation among Insurance representatives in regard to risks which are not rated by tariff. One should remember that the profit made on the tariff-rated risks is generally very moderate indeed, and that if the hazards which are not subject to tariff are accepted at less than cost price—as is too often the case—such procedure may more than absorb the whole margin of profit on tariff-rated business. It is evident that the prolongation of this state of matters must retard the progress of Fire Insurance as a science, and this is the side of the question in which our Institutes are chiefly interested. In all cases where business can be shown to be non-paying, local representatives would act wisely in their own interests, and in the interests of Insurance at large, by endeavouring to secure joint action with other underwriters. It is here that one of the aims of our Institutes—viz., "the promotion of a good understanding amongst the members of the Insurance profession"—might be

expected to bear seasonable fruit. Independent or isolated action by representatives in the way of reducing rates of premium where current terms are already narrow, or insufficient, is productive of serious and lasting injury to the business, and may lead to such a condition of demoralisation as will take long years to annul or remedy. The various Institutes comprising our Federation all aim at cultivating friendly relations and social intercourse amongst the members, and it is undoubtedly important that every encouragement should be given towards that end. We are bound together by many ties of common interest, and it is only fitting that the spirit of good fellowship should unite us still further in its friendly bonds. If we sincerely wish to allay the growing stress of modern competition, and to smooth and soften its jarring asperities, we cannot do better than cultivate, both professionally and socially, this spirit of unity, and so realise the absolute verity of the familiar old psalm which says—"Behold how good and how pleasant it is for brethren to dwell together in unity!" I need scarcely remind you, however, gentlemen, that unity and concord to be permanent must be founded on mutual respect; and that in order to inspire and maintain that measure of mutual esteem which is essential to harmony in business relationships, we must at all times be prepared to concede to others the rights and privileges which we justly claim for ourselves. I trust it will always be the aim of this Federation to foster the growth of such kindly feelings, whilst upholding a lofty standard of honour and integrity in our business life. The kindly feelings and unselfish spirit referred to have already been shown by us to some extent as a Federation, in the adoption of the proposals introduced by Mr. Brookes to establish an Orphanage for the families of deceased Insurance clerks. A further report on the initiation of this beneficent scheme is to be submitted for your approval at this Conference, and I commend its recommendations to your favourable consideration. I am afraid I have detained you too long with these remarks. In conclusion, I trust that to-day's deliberations will be fraught with satisfactory results, and that growing benefit may

continue to flow to our respective Institutes from our proceedings.

The Conference then proceeded with the ordinary routine work, considering the reports of the Committees on Education, on the Examinations, on the Journal, and on the proposed Orphanage. A very complete scheme for examinations in the future has been drawn up by a special Committee appointed for the purpose, and this was finally approved by the Conference, subject to one or two slight alterations. It was decided that the next Conference be held in Dublin in June 1902, and Mr. B. H. O'Reilly, of the *Patriotic* Assurance Company, was elected President of the Federation for the ensuing year. During the interval for lunch the delegates had the pleasure of meeting a number of Glasgow friends and of listening to a most eloquent address by the Lord Provost of Glasgow, Dr. Chisholm. At seven o'clock the delegates again enjoyed the hospitality of the Insurance and Actuarial Society of Glasgow at a sumptuous banquet, the chair being occupied by Mr. N. B. Gunn, President of the Society, and the chief guest of the evening being Mr. George M. Low, F.F.A., President of the Faculty of Actuaries.

The Chairman, Mr. GUNN, in his address, after welcoming the members of the Federation to Glasgow, said:—

It now falls upon me as Chairman to propose the toast of the evening—"The Federation of Insurance Institutes of Great Britain and Ireland." There is a feeling of federation in the air at present, and we are adopting the principle, for, as you have learned to-day, we have, by including Canada, started an Imperial Federation of our own. I shall endeavour not to take up too much of your time, for two reasons; first, that to most of you the toast needs no words of mine to commend it, and any little that I say is mainly for the information of the few here who may not know the good work the Federation is doing. And, secondly, because I was instructed by the Committee who arranged our programme, that we should ourselves be brief and leave as much time for the musical and oratorical skill of our friends from England, Ireland, and the East of Scot-

land. The Federation was started five years ago in Manchester, and was due to the initiative of the Manchester Societies. The idea was cordially taken up by the existing provincial Insurance Institutes, and now represents a combination of ten Institutes. It includes all the great centres of population except London, Edinburgh, and Liverpool. I think it is a pity that we are not strengthened by representation from these cities. It is true that work to a certain extent similar to that of the Federation is done by the Institute of Actuaries in London, and the Faculty of Actuaries in Edinburgh. The difference in their functions is such that there would be no advantage in their combining with us as regards their own particular line, but it would be a boon for those connected with Fire and Accident Offices in these cities if Societies like those forming the Federation were started there, and we should also gain by the additional strength and experience which the addition of such new Societies would bring. It seems a pity that the members of the large Offices in London and Liverpool should not help us with their knowledge of the science of Fire Insurance.

As I mentioned, the Federation has been only five years at work, and for a child of that age its record is certainly marvellous. You may perhaps think, that as I am a member of it, my views are apt to be unduly favourable—but my connection is really an honorary one, and while knowing what is being done I am able to form an impartial opinion. The educative functions of the Federation are undoubtedly the most important. The problem they had to face was in what way they could best train the younger men in the Insurance Offices. Each Society had its own meetings, where papers were read on the science and practice of the various classes of Assurance—Fire, Life, and Accident—but not only was the area limited from which the information could be obtained, but also it was felt that information was not supplied in such a manner that it could be properly digested. By combination into a Federation, the best information provided by the most experienced men is brought before all the members. The different Societies, too, were apt

in the past to go over the same ground, and thus much time and energy were wasted. The Federation stepped in, and by allocating different subjects to the Societies which were most likely to treat these subjects effectively, enabled a much larger ground to be covered, and covered much better than before. At the end of five years the result is that the student, instead of having only the papers of his own Society, can refer, or will shortly be able to refer, to the four volumes of Transactions, with ample information on all the important subjects. The science is not exhausted, but marvellous strides have been made in the five years, and I do not doubt that we shall soon have as complete a text-book as can be compiled. The examinations, for which, mainly, the Journal is prepared, have made great progress. They have only been held for three years, and probably some time will elapse before they are fully taken advantage of.

I shall not take up your time further, and now ask you all to join with me in wishing a long and useful life to the Federation. It has started well, and let us, as far as we can, help it in its good work.

Report submitted to the Conference, held at Glasgow, 14th June, 1901.

Proposed Insurance Clerks' Orphanage.

In accordance with the Resolution passed at the Conference held at Bristol, 8th June, 1900, letters of invitation were addressed to Insurance Officials whose names were proposed, to become members of a Provisional Committee (with power to add to their number) for the purpose of proceeding generally with the inauguration of the Insurance Clerks' Orphanage, and it is with satisfaction the Executive Committee report that the following gentlemen consented to become members of such Provisional Committee :—Messrs. Wm. Perowne Abel, Chief of Foreign Department, Norwich Union Fire Office (Norwich); J. H. Boocock, Manager, Commercial

Union Assurance Co. (Birmingham); JOHN G. BOSS, Manager, Royal Insurance Co. (Newcastle); ALBERT D. BROOKES, Secretary, Alliance Assurance Co. (Bristol); J. A. CUNNINGHAME, Secretary and General Manager, Yorkshire Insurance Co. (York); FRANK DALTON, Manager, Norwich Union Fire Office (Birmingham); JAMES HASLAM, Manager and Secretary, Employers' Indemnity Insurance Co. (Nottingham); S. G. MOXEY, Superintendent, Prudential Assurance Co. (Bristol); CHARLES POVAH, Sub-Manager, Lancashire Insurance Co. (now "Royal") (Manchester); C. R. QUINTON, Norwich Union Fire Office (Norwich); H. H. RAY, Secretary, Hand-in-Hand Insurance Society (London); J. B. ROBERTS, District Manager, Sun Insurance Co. (Leeds); J. B. TENNANT, Secretary and Actuary, Friends' Provident Institution (Bradford).

A Meeting was held at Birmingham on the 17th May, 1901, when the Articles of Association submitted were read and fully considered.

It was resolved:

THAT the Memorandum and Articles of Association of the Bank Clerks' Orphanage be accepted as the Memorandum and Articles of Association of the proposed Insurance Clerks' Orphanage, with such modifications as were determined on at the Bristol Conference, and under direction and advice of Solicitors to be appointed.

Also:

THAT the proposed Insurance Clerks' Orphanage be Incorporated under the Companies Acts and Registered in London.

Also:

THAT Messrs. GARD, ROOK & WINTERBOTHAM, of 2 Gresham Buildings, Basinghall Street, London, the Solicitors to the Bank Clerks' Orphanage, be approached with regard to adapting the Articles of Association of the Bank Clerks' Orphanage to the requirements of the Insurance Clerks' Orphanage.

Also:

> THAT a Meeting of the supporters of the Scheme be called in London on an early date to receive and confirm the report of the Provisional Committee appointed, and to elect a General Committee with power to Incorporate the Orphanage.

The Provisional Committee will then resign their office after submitting their report,—all the members being eligible for re-election.

It is felt, with the formation of a Provisional Committee so representative, and the decisions arrived at, considerable progress has been made. The Executive earnestly recommend that every influence should be brought to bear with a view of securing the presence of leading officials at the forthcoming Meeting in London—where the Registered Offices of the Orphanage should be, and to obtain the active interest and support of all those engaged in the profession for so desirable an object, which at no distant date should be an accomplished fact.

**** For all statements made, and opinions expressed, in the papers of this volume, the respective writers are alone responsible.*

THE ASPECT OF ELECTRICITY FROM AN INSURANCE POINT OF VIEW.

WHEN your past President, Mr. Roberts, asked me to address you on the subject of Electricity, I felt that I ought to accede to his request, because I consider everyone in the Insurance profession in the Metropolis owes a debt of gratitude to all the provincial Institutes for their zeal and energy in the promotion of Insurance interests and in the cause of general Insurance education. Yet it is not without some misgivings that I come before you to-night, knowing well that the subject on which I have to write has been largely written upon and lectured about at several of the provincial centres by persons more intimately engaged in electrical work than I am myself. I have to acknowledge my obligation to the published addresses of your lecturers, which I have read with profit and pleasure at different times since I have been connected with Insurance.

Whether London will ever have an Insurance Institute, and join in the work which the provinces have initiated, I do not pretend to say; but it is very evident that the profession in London, and especially the junior members, in the matter of education do not enjoy the advantages which you possess. It has ever been that big cities have been kept intellectually alive by attracting to themselves the most energetic minds from the country, and I suppose in the matter of Insurance there is no exception. It has been well said that to do creditably in this modern world one should know something about everything, and *everything* about something. It is in bringing this about that we have the special function of all societies and institutes—viz., to give to their members correspondence and interchange of ideas on all subjects correlated to their particular profession. To Insurance men, pray what subject cannot be proved to have some bearing, relation, or operation among the things with which they have to deal? At the present time it is very difficult, and will be more so later on, to find anything in which electricity has *not* had some

connection. To the fire insurance man electricity ramifies through all the property he insures, and to those engaged in other branches of insurance electricity is ever asserting itself in some peculiar way. It is no exaggeration to say that without its aid modern life would be quite impossible, facilitating as it does the quick interchange of things and ideas, and aiding generally in the direction and control of the forces of nature for the use and convenience of mankind.

The study of electricity must then be counted of first importance in every profession and trade, and well befitting the attention and leisure moments of Insurance men. I shall endeavour in what I have to say to bring before you only the salient points or characteristics of electrical action, which will enable you to understand the real operation of electricity in modern life. I shall try to look at electricity not from any inside point of view, revealing the technicalities and intricacies of the subject, and showing its direction, limitation, and control (which can only be done by one who has made this subject the main business of his life), but from the outside or aspect point of view, such as arrests the attention and calls forth an appreciative interest in the spectator.

Historically, electricity may be said to commence with the researches and experiments of Dr. Gilbert, of Colchester, in the 16th century, and to have been continued by the labours and observations of many learned men during the 17th. Dr. Benjamin Franklin did much to classify and explain the observations of his predecessors, and introduced into the science the ideas of positive and negative electrical conditions. His memory ought to be well cherished by all Insurance men, for not only did he found an insurance company, but he first showed the identity of lightning with experimental electricity, and showed how buildings might be protected from the disruptive effects of lightning shocks. The appearance of this benevolent old man in the early annals of electrical science creates such a charm on the imagination that it will not be without interest if I abstract from an ancient account the simpleness and earnestness of mind with which he made, for the first time, the dangerous experiment of extracting electricity from the clouds. "Previous to the year 1750 Franklin drew up a statement, in which he showed that all the general phenomena and effects which were produced by electricity had their counterpart in lightning.

"After waiting some time for the erection of a spire at Philadelphia, by means of which he thought to bring down the electricity of a thunderstorm, he conceived the idea of sending up a kite among the clouds themselves. With this view, he made a cross of two *small, light* strips of cedar, the arms being sufficiently long to reach to the four corners of a large thin silk handkerchief, when extended. The corners of the handkerchief were tied to the extremities of the cross, and when the body of the kite was thus formed, a tail, loop, and string were added to it. The body was made of silk to enable it to bear the violence and wet of a thunderstorm. A very sharp pointed wire was fixed at the top of the upright stick of the cross, so as to rise a foot or more above the wood. A silk ribbon was tied to the end of the twine next the hand, and a key suspended at the junction of the twine and silk.

"In company with his son, Franklin raised the kite, like a common one, in the first thunderstorm, which happened in the month of June, 1752. To keep the silk ribbon dry, he stood within a door, taking care that the twine did not touch the frame of the door; and when the thundercloud came over the kite he watched the state of the string. A cloud passed without any electrical indications, and he began to despair of success. He saw, however, the loose filaments of the twine standing out every way, and he found them to be attracted by the approach of his finger. The suspended key gave a spark on the application of his knuckle; and when the string had become wet with the rain, the electricity became abundant; a Leyden jar was charged at the key, and by the electric fire thus obtained spirits were inflamed, and all the other electrical experiments performed which had been formerly made by excited electrics."

Modern research has, however, extended our knowledge of this branch of applied science. Franklin's idea of protecting buildings by causing a silent discharge of electricity off the sharp-pointed ends of lightning conductors, and in a measure quietly preventing a dangerous accumulation of potential between thunderclouds and the earth, or, if insufficient and incapable of doing this, of conducting a discharge "to earth," seem to take a second place to the ideas which are now considered of importance in designing lightning conductors. Modern research seems to indicate that a disruptive lightning discharge is of the nature of an extremely rapidly alternating current; and, as such, requires quite a

different kind of conductor to the simple copper rod or band for a uni-directional discharge. One authority says—"The use of copper for lightning rods is a needless extravagance. Iron is far better; ribbon is slightly better than round rod; but ordinary galvanised iron telegraph wire is good enough." At the present time there does not appear to be a universal consensus of opinion on this subject; and lightning conductors are now being designed partly on Franklin's principles and partly on modern principles, according to the whim or fancy of the designer. The fact is, indeed, that close experimentation with lightning is a highly dangerous undertaking, and is not now directly undertaken by any philosopher; hence opposing views, which cannot be settled by experiment. Let all credit, then, be given to Franklin for having been the first to explore in this direction.

Among the many eminent men who have laid the foundations of our present electrical knowledge, and from whose labours have sprung all our electrical enterprises, may be mentioned the names of Galvani and Volta, Count Rumford, and Michael Faraday.

To-day the tide of electrical discovery is still advancing by the labours and researches of hosts of scientific workers in all countries. The number of electrical societies, of technical institutes and journals, all of whom are enjoying the robustness and vigour of youthful existence, is an evidence that electrical science, and its application to the needs of mankind, is in the full tide of progress. I feel quite incapable of stating in any comprehensive way what is being sought after at the present day. I gather, from quite cursory reading, that ether vibrations, Leyden jar discharges, the behaviour of extremely rapidly alternating currents, the effect of electrical action amidst the chemical and molecular transformations of bodies, and the general study of the transformation of *energy*, are all tending towards some broad and grand generalisation which will impart some simplicity to our statements of the laws of the material universe. From the time when Benjamin Franklin brought electricity out of the clouds till now, when Marconi is sending electrical waves through them, and possibly mountains as well, there never was in the history of the world such a period of intellectual stimulation and material prosperity so widely spread among all peoples, owing to the competition of nations, and the application of science to industry.

The principle of the conservation of energy, which is that

energy can neither be created nor destroyed, is the chief corner-stone of present-day knowledge. It arose directly from Count Rumford's celebrated experiments in cannon-boring in 1789—a year memorable for reformation of thought in other spheres.

An extremely interesting account of Rumford's experiments is given in Tyndall's "Heat: a Mode of Motion." Rumford proved conclusively that the heat developed in the boring of a cannon arose directly from the mechanical work expended in boring. This was the death-blow to all theories that heat was a subtle fluid created by friction or given out by burning bodies. When a *force* is applied to anything, and motion results, the energy manifested is the force multiplied by the distance moved. If the force is measured in pounds, and the distance in feet, the energy is called foot-lbs. Rumford showed that this energy has a certain equivalent in heat. The exact expression of the equivalency was finally settled by Dr. Joule, of Manchester, in about 1840. It is that 772 foot-lbs. are equal to the heat necessary to raise 1lb. of water 1° Fahrenheit in temperature.

The discovery of the conversion of mechanical energy into electrical energy is due to Michael Faraday. In 1831 he commenced his experiments on electric induction, and showed how, with magnetic force, and the movement of a copper conductor through the region of that force, a current of electricity was induced, not created, for work has to be expended. It is solely as a result of the doing of work that the electricity is produced. Conversely, when electricity disappears, either mechanical work or heat results. If too much current flows through a conductor, its potential falls, and the conductor becomes heated. In the same way, in a steam engine, when the steam expands in the cylinder, doing useful work, an equivalent quantity of heat disappears from the steam. When electricity passing through acidulated water causes oxygen and hydrogen to appear, the electricity is not lost, but changes into the atomic energy of atoms (which is of a potential kind), and is measured by the heat given out when the oxygen and hydrogen reunite again. It may be said, in a general way, that energy or work, heat and electricity, are convertible terms; and in the saying of this we are stating the bottom principle of all material science. Energy is vibration, motion, temperature, the life and essence of all things. It is from the clear understanding and grasping of this that all fruitful and useful discovery has resulted. You may perhaps ask, what has

all this to do with Insurance? Surely a very great deal; for when a fire is raging furiously there is a great manifestation of latent energy, and as energy cannot be destroyed, we convert it into some other less harmful form, by absorption into water heat units.

Of the forms in which energy is available to us, some are more useful than others. Electricity is perhaps the most useful of all, for we can transmit it economically great distances, and convert it, with very small loss, into either power, or light, or heat.

To think of the nature of electric energy leads at once to the consideration of the ether of space. This is one of those subjects which hardly concern us as practical and business men; but we must always remember that what is the tool and implement of the philosopher to-day is apt to-morrow to have an intimate concern with the practical applications of science which may come before us. I cannot do better than give you a short abstract from an address delivered by the late Dr. William Andersen before the Institution of Civil Engineers, where this subject is very clearly and forcibly spoken of:—"One of the loftiest of abstract conceptions relating to the structure of the universe, the product of many acute minds of this century, is the imagining of a substance of infinite tenuity, but of immense elasticity, which permeates all space and every substance. It cannot be seen or felt or weighed; its composition is unknown; it cannot be pumped out of a closed vessel; it does not appear to offer any resistance to the motion of planetary bodies; and its existence is only made manifest by its property of transmitting chemical rays, light, radiant heat, *electricity*, and probably some more recondite forms of energy, at enormous velocity, from the remotest regions of the universe; and by means of vibrations, the nature of which, the astounding frequency, and minute pitch, have been determined by mathematicians. It is pardonable in human beings to disbelieve in the existence of the luminiferous ether, even though the profoundest thinkers and most successful workers of the present day may have all the conviction of Lord Kelvin, who has declared that it is the only substance that we are confident of in dynamics; the one thing we are sure of is the reality and substantiality of the luminiferous ether." In an address delivered by the Marquis of Salisbury before the British Association is the following:—"Ether may be described as a half-discovered entity. I dare not use any less pedantic word than entity to designate it, for it would be a great

exaggeration of our knowledge if I would speak of it as a body, or even a substance. When, nearly a century ago, Young and Fresnel discovered that the motions of an incandescent particle were conveyed to our eyes by undulations, it followed that between our eyes and the particle there must be something to undulate. In order to furnish that something, the notion of the ether was conceived, and for more than two generations the main, if not the only, function of the word 'ether' has been to furnish a nominative case to the verb to undulate. . . . Whether, outside the influence of matter on the motion of its waves, ether has any effect on matter, or matter on it, is absolutely unknown. And even its solitary function of undulating ether performs in an abnormal fashion, which has caused infinite perplexity. All fluids that we know transmit any blow they have received by waves which undulate backwards and forwards in the path of their own advance. The ether undulates athwart the path of the waves' advance. . . . It is not easy to fit in the theory of electrical ether waves with the phenomena of positive and negative electricity, and, as to the true significance and cause of those counteracting and complementary forces to which we give the provisional names of positive and negative, we know about as much as Franklin knew a century and a half ago."

It is the proud achievement of present-day scientists and engineers that the ethereal manifestation of energy called electricity is utilised with extremely little waste. Our dynamos have extremely high efficiency; that is, they receive mechanical power and give out electrical power with hardly any loss in the process.

If you once thoroughly realise that the fundamental use of all dynamos and motors is to transfer energy from one place to another, and then give Light, as in incandescent lamps and arc lamps, or Mechanical Force, as in motors, the whole seeming complexity of modern engineering vanishes. Of course, the machines themselves are none the less complex in their internal working; but, seeing their purpose, what they are supplied with, and what they give out, their comprehension will give rise to feelings of pleasurable satisfaction. One can then with confidence understand and judge of the application of electrical appliances in industries and as they may come before us in our business duties, much in the same way as we understand and find useful our watches, though we may know nothing of how watch mechanism operates.

Reverting again to electro-magnetic induction discovered by Faraday. If a circuit or closed conductor be rotated, or so moved that when set between the poles of a powerful magnet it embraces a continually changing number of lines of magnetic induction, a current is established in that conductor. Where electricity is distributed over a large town all the conducting mains and leads really form part of the dynamo circuit; and when the dynamo is being driven a portion of this network of wires is receiving electro-magnetic induction by the expenditure of work in the steam engine driving the dynamo. Our wonder is excited when we know that if a person (miles away from a generating station from which he receives an electrical supply) desires light or power, by the simple process of making a switch contact he causes an instantaneous transfer of energy from the generating station to himself.

It is an easy transition from the consideration of the electrical manifestations at both ends of a system of supply to the connecting copper conductors and their insulating materials. An ingenious writer has suggested that it is safe to assume that among the lost arts of the ancient world electricity had no place, for among the relics of those arts no copper or other conducting material, covered uniformly with silk, cotton, or other non-metallic substance, has ever been discovered. The art of insulating wire is one of the essential things in the making of all electrical apparatus. It would be as practical to supply water to all parts of a house without pipes as to try and work with electricity without an insulating covering to our conductors. As illustrating the progress in the arts that have grown up with electricity, we read that Joseph Henry, the American philosopher, spent many months in wrapping wire with strips of cloth in order to make his electro-magnets, by means of which he showed the possibility of transmitting signals to a distance by electricity. To-day such covered wire is produced by exact machinery in less than an hour, and costing only a few pence.

In 1827 Dr. G. S. Ohm enunciated three great practical principles about electricity flowing in wires—1st, that it had quantity; 2nd, that it had pressure; and 3rd, that the wire opposed resistance, which gave rise to heat. These three things are in full operation when electricity is being conducted along a wire. There is "current" measured in amperes, "electromotive force" measured in volts, and the wire has a physical property, inherent

in itself, of "resistance," measured in ohms. Any one of these three is dependant or is a function of the other two.

On the exact relationship which holds between these three properties nearly all modern electrical designing is based. So wide is the utility of this relationship, and so frequent its application, that we almost consider that the analogy of a quantity of water flowing at a certain pressure, in a definite direction, and against the skin resistance of the internal surface of the pipe, is a strictly true analogy with the electric current. Yet there are many electrical phenomena taking place in quite common apparatus that show this analogy to be far from true. Take, for example, the case of a transformer, in which two separate and distinct circuits of insulated wire are wound round a laminated iron core, one over the other. There is no mechanical contact of the circuits, yet the whole energy of the primary current is transferred into the energy of the secondary current, through the intervention of magnetic induction.

In view of the extended use of alternating currents, the consideration of how the wire carries the current is of great practical importance. It is now recognised that the energy of an electrical current lies not in the wire that carries it but in the surrounding space, which is filled with magnetic etherial whirls; and it is through these that all induction effects arise. The wire is now to be looked upon as a mysterious steering rod, in which the work of steering is made manifest by the heat arising from the resistance properties of the conductor. In fact, for alternating currents, when the frequency is very high, only the surface of the conductor comes into play, and hollow tubes are found to conduct better than solid rods.

Of the conducting metals, copper is almost universally used for two reasons—1st, because its resistance is extremely low, and for a given electrical capacity its size is small; and, 2nd, the cost of covering the copper conductor with insulating material is much less than if, say, iron were used, when the sectional area would have to be ten times as great to have the same resistance. The material of the conductor is the most practical question in electricity. On it depends the design and construction of everything, whether the current shall be continuous or alternating. If copper had been a much cheaper material than it was, it is doubtful whether alternating current working would have made the advance it has done in public supply undertakings. The

present price of copper is £72 per ton, and it is because the cost of mains and feeders mounts up so much in all estimates for the distribution of power that engineers have been driven to work in another direction to carry out their projects. The sectional area of a conductor is proportional to the amount of current to be carried; but the energy carried is the product of the current multiplied by the pressure. Energy can then be increased by leaving the current alone and simply increasing the pressure. It is the present tendency of all electrical undertakings to increase the pressure, making the mains already laid down capable of doing more duty. There are, however, limitations to the pressure. When continuous current dynamos are designed for pressures much above 500 volts, sparking and difficulties arise at the commutator. The Board of Trade, in the public interest, also limits the pressure between a pair of mains that may be brought into a dwelling-house to 250 volts. To meet all these difficulties, present practice lies between a distribution with alternating current, at a potential of 2000 or 2500 volts, and a system of distribution by a continuous current at 440 or 500 volts, on the so-called three-wire system. I do not propose to go into any detail on these subjects. Both systems have their peculiarities and complexities. It is considered by some electricians that it is better to save 8 per cent. in capital cost, and have a complex system of supply, rather than to spend the money in conductors and have a simpler supply. The cost of the mains in electric supply companies varies from 27 to 37 per cent. of the total cost of the undertakings. At the present time there may be said to be rivalry going on among engineers between those who advocate continuous-current working and those who advocate high-pressure alternating currents working. This question does not concern us in the Insurance profession; we simply look on as spectators. Dr. Silvanus Thompson, in his address to the Institute of Electrical Engineers, predicts the survival at all points of the alternate current system of working.

It is not at all an unprofitable reflection as to the manner in which progress in applied science takes place. Progress takes place along the line of minimum cost. That which costs less, and does the same duty equally as well as something else which costs more, takes precedence of it. The permanence of any one method of transmitting energy simply depends upon the permanence of the relation of its cost to that of other methods. There may,

therefore, be expected continual change and no finality, and I think it quite as well that such should be the case, for until we arrive at the best principles of action to suit human needs, it would be useless from an artistic point of view to put expression and extravagance into any human production. It necessarily arises that things are now-a-days designed and built to suit only the most pressing needs of the moment, and as those needs and fashions change, so our structures and appliances become antiquated, and are cast on one side. These facts appeal to me very strongly in trying to account for the very greatly increased fire hazard of modern times and the universal rise in rates of insurance.

Apart from competition among electrical methods, electrical methods are in competition with other systems. The so-and-so electric light and power company is a common title to many of our large companies, revealing clearly that light and power as applied to human needs is the essence and main end of their existence. Of other systems now in full operation to this end is the gas obtained from the destructive distillation of coal. It did appear, until quite recently, that our old gas companies would be very severely hit by the handiness and convenience of the electric current for producing power and light; but quite recently the improvements in the methods of obtaining light and power from coal gas, with great reduction in cost, have given a fresh lease of life and new vigour to gas companies.

As regards distribution of power, there are certain other systems of working which will always continue to be used, on account of certain inherent advantages which they possess. I allude to the transmission of power by water under pressure and by compressed air. In the working of lifts and elevators the hydraulic method is very hard to beat by the electric; and as regards compressed air (without alluding to the marvellous wonders predicted of liquid air), it still holds its own against electric applications in machinery and appliances in coal mines, and somewhat, though to a much less extent, in the working of tramways. The development and transmission of power is one of the most interesting studies of modern engineering. When the standard of measurement for the different systems is the cost of a horse-power delivered to the consumer or person who wants it, it is quite surprising how, in different cases, and under conditions most diverse, the price varies, clearly showing, among other systems which are actively compet-

ing, how increase of cost is usually attended with some other collateral and special advantage. Time will not permit of my going further into this subject, but there is one thing in regard to lighting which I would like to state, and in which electricity comes very largely before Insurance men. It is the efficiency of the electric incandescent lamp, as compared with other sources of light. I give this on the authority of Professor Vivian Lewes. Concurrently with the production of light, heat is produced, and the following are the relative proportions in which both light and heat are developed in our common illuminants:—

Burning candles	98 heat,	2 light.	
Oil lamps	98 „	2 „	
Coal gas, flat flame and Argand burner	98 „	2 „	
„ regenerative burner	93 „	6 „	
Electric, Geissler tubes	97 „	3 „	
„ arc lamps	90 „	10 „	
„ incandescent lamps	95 „	5 „	
The magnesium light	85 „	15 „	
The light of the sun	70 „	30 „	
And in the gas incandescent mantle ...	88 „	12 „	

You will justly appreciate how the widely-used electric incandescent filament is entirely eclipsed in efficiency by the modern gas incandescent mantle. This almost recent improvement in gas lighting has reacted already on the incandescent electric light, and there are now said to be lamps made by Nernst and Welsbach in which the consumption of current is 1½ watts of energy per candle-power of light produced, instead of 3½ to 4 as now obtaining. There can be no doubt that in the near future these lamps will pass out from the laboratory stage and be commercially adopted, thus giving us fresh conditions of hazard to investigate.

From a fire-insurance point of view, no portion of electrical apparatus is more important than insulating material, which covers all mains and wires to confine the energy transmitted to its patn, and makes installation work in buildings safe and free from fire hazard. Of the many substances used as insulators very few are fit to cover conductors. Indiarubber and its compounds universally hold the field. Paper, jute, or other fibrous material thoroughly saturated with resin oil is now being largely used both for indoor and outdoor wiring; but for the former purpose it is not nearly so reliable as vulcanised indiarubber. We have yet to

learn from experience whether age affects the good insulating properties of vulcanised indiarubber.

I have already alluded to the incessant attempts of engineers interested in the development and spread of the electric light to cheapen the cost of the means they employ to accomplish this. The cost of wiring a building forms no inconsiderable portion of the total outlay required to install the electric light. The great idea with some is not to rest in their efforts until the cost of wiring is equal to or less than that of fixing gas pipes; then builders of houses will adopt that which is cheaper, and will in all new work lay down electric wires instead of gas pipes, and tenants will perforce have no option in the matter of choosing between gas and electricity. I venture to think that electric light conductors can never be as cheap as gas pipes, simply because electricity is a much more subtle and delicate thing than gas, and will always require more delicate care and handling and more refined apparatus. One famous proposal is to have only one conductor insulated, and the other simply either as a naked metallic envelope around it, or as a separate bare copper wire. It is alleged that its great opponents are the station supply engineers and the Insurance Companies; the former, because risk of discontinuity of supply is much increased, and the latter because the risk of fire being set up may be increased. If we are acting in the way of a drag on the electric light industry, which I do not think is the case, we are evidently in good company, and can afford to wait until central station engineers feel confident that the complete earthing of one conductor will not affect the constancy of supply. As present practice stands, where the conductors enter a building we put double pole fuses. Why do we have this double protection, seeing that, if more than the proper current flows through the house circuit, the fusing at one point is sufficient to stop the current? Well, the reason is that, in any network of supply, "earths" are bound to occur; that is to say, they do occur from accidental causes. Then if one house has an earth on the positive conductor, and another house one on the negative conductor, current will flow, avoiding one of the main fuses in each house; therefore to protect ourselves against this we place two fuses on our entering mains. Now, suppose that one of the mains entering the house is at earth potential, as is now almost universally the case where current is supplied on the three-wire system, it is evident that no electrical circuits can be established between

neighbouring buildings through the "earth," because an earth, say on any positive main, results at once in the fuse "blowing." An earth on the negative main means nothing, as, the conductor having the same potential as the earth, no current can flow through the negative conductor; consequently it does not need fusing. When a conductor is at earth potential it is much the best to put neither switches nor fuses on it.

I think it may be considered that an earthed system of supply is safer than one not earthed, for each building is independent of any fault in any other one; and from this it is a very easy deduction that the concentric system of wiring is the safest. This subject of earthing conductors has an important bearing on Fire Insurance hazard; and it is an artifice that central station engineers have adopted to bring double the potential difference within a building to that allowed by the Board of Trade, and yet at the same time without contravening the Board of Trade rules. The advantages and disadvantages of earthing the middle wire of a three-wire system are very clearly set out in a recent paper by Mr. Wordingham, of Manchester. The main advantages are the following:—(1) By earthing the middle conductor the extreme difference of potential that can be obtained by any one of the conductors from earth is halved, and all can be handled not only with great safety but practically without inconvenience. (2) The stress on the insulation is halved. (3) All three conductors may be taken into a consumer's premises for all pressures up to and including 500 volts pressure across the outers without contravention of the regulations of the Board of Trade (this advantage is undoubtedly by far the most important). (4) Immediate notice of a leak on one of the outer conductors is given. The disadvantages of earthing the middle conductor are: (1) If a leak exists on one conductor current is continually forced through it, thus causing in many cases complete destruction of the insulating material. (2) A leak on one conductor produces a short circuit on one side of the system of redistribution, unless the earth connection is removable at will. Mr. Wordingham's reasons which I have given apply just as forcibly to the internal wiring of a house as to the supply mains in the streets. The question of course arises, What is the good of the insulation on one of our pairs of wires, if it is always kept at earth potential? Why, no good at all. But supply companies make us insulate all our internal wiring so that they may take away the connection to

earth which they have made, and not set fire to our buildings. I think we have always taken comfort to ourselves that with an ordinary system of supply *not earthed*, we had a double security in having both conductors well insulated. For any current to flow there must occur a leak on both conductors. With an earthed system of supply a leak on the conductor means either blowing the fuse or setting fire to the place. Where two conductors are placed in ordinary metal piping, and one of these conductors is earthed, it is most important to connect that metal casing efficiently to earth. No red lead or other jointing material should be used; the screw threads should be quite bright and dry, so as to make a good contact.

I have gone somewhat fully into this matter, because the three-wire 460 to 500 volt system continuous current is being largely adopted all over the country, and the question of insulation and leakage is a very important matter as regards the safety of buildings from fire.

The development of electrical industries in this country began to make remarkable strides after the passing of the Electric Light Act of 1888. Before that time the law rather restricted the introduction of capital into electric supply undertakings by stipulating that after 21 years municipal and local bodies should have the power of taking over such undertakings at their intrinsic value, without any compensation for goodwill. By the 1888 law the period during which a supply company may carry on its undertaking was extended to 42 years, so that under good management a reserve fund might be accumulated which would compensate shareholders for the loss of their business. It is under this condition that all electrical companies are now working.

The present extent of electrical supply in Great Britain is as follows:—At work in the provinces—152 stations, and 38 in London and district. In course of construction—in the provinces 42, and in London 8. Projected undertakings—27 provincial and 6 in London, making, including those working and under construction, in all 240 stations. Two years ago the number was only 135, so that the immense progress may be judged. As compared with the United States and some foreign countries, we are much less equipped in this department of modern civil life; but we are rapidly making up the leeway which our national conservatism has allowed us to fall into. As far as our Insurance

profession is concerned, we are doubtless very much better off in having undertaken these things after they have been well tried and experimented with abroad. We have been enabled to adopt only good and safe systems. On the other hand, our want of enterprise has given the foreigners an initiation into all the business correlated to electricity, which they have not been slow to take advantage of.

So great is the progress in all modern businesses, that those who first develop and work them, other things being equal, can easily maintain their lead. Probably one of the best and most successful electrical works is that of the Central London Railway, which was entirely engineered, financed, and built by Americans.

From a recent report on the progress of electricity in Germany, it appears that in 1890 there were only 27 completed electric supply stations. In March of this year there were 652 in operation; and the number of places now illuminated by the electric light there is greater than that by gas in the ratio of 900 to 850. It must be stated, however, in justification of ourselves, that foreign countries are favoured by nature more than we are, with resources that tend to an economical development and spread of electrical projects. In our country we have many vested interests that do not tend to public and municipal enterprise. On the Continent, for example in Switzerland, practically the country has been waiting for industrial development for centuries, for the advent of electricity to enable it to use its waterfalls. In France, Germany, Italy, Switzerland, the United States, electricity in some practical form is being adopted all over those countries.

This universal application of a very convenient form of energy to the needs of mankind in all countries leads to its speedier application in all industries; and as our Fire Insurance Companies have extensive connections in all countries, our education is sadly neglected if we do not understand somewhat of the principles of electrical science.

Having spoken in a general way of what electricity is, how it comes to us, and of its most conspicuous features, I will now allude briefly to the character of the apparatus in which it is utilised, and which has been more or less moulded or evolved, having in mind the fear of causing fire. All electrical apparatus, well designed, has a limiting value for the current which may pass

through or be consumed in it. Owing to accident, wear and tear, improper use, or through gradual failure somewhere, more current may pass through an apparatus than it is calculated to bear; undue heating at once takes place, and, if there be no protective device, fire results. The universal remedy for this is what is known as a "fuse," something which is in the path of, or, as it is said, "in circuit" with the flowing current. When this operates the flow of current is stopped. Fuses are of two kinds, those which depend upon a burning out of the circuit, and those operating by magnetic attraction produced by the increase of current. The former are used for all purposes, the latter are more or less complicated and liable to derangement, and are generally only used for special purposes and under skilled supervision.

The proper fusing of wires is the most essential protective feature in all electrical work. It is practically the only thing that can be done. There are endless designs for fuses; but so long as they can be relied upon to work without failure, or "arching" as it is called, it really does not matter how they are constructed. I think the best form is some kind of porcelain bridge, in which the fuse wire is fixed, and which permits of being freely handled, placed in and removed from position at will, thus functioning as switch as well. An electrical inspector must examine fuses thoroughly, and see that they are what they should be. A thorough examination elsewhere is superfluous if the fuses be neglected.

It often happens that fire is started whilst the fuse is acting, owing to leakage or escape of electricity through some combustible channel. In all good apparatus, when escape might take place in this manner, there is something in the nature of a fireproof and incombustible cover. This accounts for the wide use of porcelain and china bases and covers, and of metallic conduits.

In cases where inflammable gases are to be apprehended we have air-tight fittings; and again in other cases where the electrical appliances have hot surfaces we find exterior appliances to keep away surrounding combustible bodies, as in lighting and heating apparatus.

It is in judging of these things, as to whether such extraneous and non-electrical portions of fittings and apparatus properly fulfil their purpose, that an electrical surveyor's experience tells.

It is greatly to be regretted that our Fire Insurance Companies do not make year by year an official record of electrical failures resulting in fire. We should then know and appreciate the value of the rules which are in vogue amongst us. Such a record would demonstrate in a manner better than argument, to electrical engineers and users of current, that our rules are neither vexatious nor unpractical. It would be highly educational to ourselves, forming as it would a basis from which our rules might be amended and kept constantly abreast with the changes and developments in the applications of electrical science. In America, as many of you are doubtless aware, such a record is maintained by Insurance interests, and issued in small quarterly reports.

Through the kindness of Mr. Merrill, jun., electrician to the Electrical Bureau of the National Board of Fire Underwriters, I have obtained copies of the most recent reports. They form an interesting commentary on the American rules, and it seems to me to justify their strict enforcement.

They show what, for want of a better term, I will call "the blundering human nature hazard" that occurs in dealing with electrical things. This kind of risk would, I think, not be the same in two such countries as England and America, where social life and customs are so different, and therefore these reports do not give us a proper basis at all to work upon.

What electrical fire risk is in this country I do not know, for we have no record of accidents. I imagine it is not so great as in the States; but then we are only just beginning to make use of the electrical current which is laid on at our doors. Perhaps, as time goes on, electrical fires may unpleasantly increase. I think, therefore, that the Tariff Committee which governs all our united interests should arrange for the collection and publication of electrical accidents resulting in fire. We would thus make our early experience useful in the reduction of a greater loss which would otherwise occur later on.

As an instance of the good accruing from an Insurance interest publishing in a classified form the accidents which it covers I will allude to the recent annual report by Mr. Michael Longridge, of the Engine Boiler and Employers' Liability Insurance Company, wherein a section may be found dealing with the Company's branch of electrical business. Here we find the causes of accidents explained, and improvements suggested, whereby liability to

breakdown may be prevented or lessened. The remarks about the working of electro-motors will be found to be of particular interest to all fire surveyors; and, in fact, I know of no other place where so practical and useful information about the working of motors is to be found. The reason why the information is sound and good is that it is derived from a wide experience.

There is a tendency with us all to draw conclusions from insufficient data, and to insist too much on our own special fads and fancies. The careful collection, compilation, and publication of British electrical fire loss statistics would lead to a truer appreciation of the fire risks of electrical things.

Gentlemen, what are the changes that electricity has brought about, and is bringing about, in all the surroundings of our daily life? In the first place, it gives us a very convenient source of light—a light which is becoming universally used even in very small townships, not in virtue of its economy, but of its convenience. By a simple switch contact it is lighted or extinguished; gives off no deleterious products, and lends itself better than any other form of illumination to a proper and economical distribution of light, and, I suppose, generally in its management less thought is required than in any other system. It is this latter point, when fire risk is considered, that makes it the safest form of illumination.

In the second place, as a form of energy, it is very widely applied in all industrial processes; and, from the little loss resulting in its transmission, is rapidly altering the aspect and crowded nature of many of our workshops. It is now no longer necessary to build our factories in compact blocks of many storeys, on account of the convenience of getting power from rotating shafting with belts, and of which we use as little as possible, in order to avoid the heavy frictional losses of bearings and belts. Electro-motors applied to factories lead to better design and separation of buildings, and to an order and cleanliness which those who have not seen a modern electrically-driven factory would hardly credit.

In the third place, it is surely and gradually manifesting itself to be the most economical and convenient means of transport for urban and suburban districts, giving quick and cheap transit to populations who can spread themselves out and enjoy more healthy surroundings.

In the matter of Light, Power, and Transport electricity has worked, and is working, a complete revolution in all that pertains to our industries and commerce, and so must have profound influence on the losses which it is our duty to meet.

BERTRAM CHATTERTON,
Ass. M. Inst. C.E.,
Surveyor, Yorkshire Insurance Company,
Princes Street, London.

The Insurance Institute of Yorkshire,
November 30th, 1900.

COAL-TAR DISTILLING AND CHEMICAL MANURE MANUFACTURING.

COAL TAR, which is a by-product in the manufacture of illuminating coal gas, is a black, viscid fluid of characteristic and disagreeable odour, and is of an extremely complex composition. The coal tar is obtained from the gasworks situated in the surrounding districts, and is conveyed to the tar distillery by means of numerous tank barges, railway tanks, or casks. On its arrival it is pumped into large store tanks, both under and above ground. The first treatment of the coal tar consists in distilling it, and collecting the distillate in a number of fractions in the following manner, viz.:—

The tar is pumped from the store tanks into a series of large wrought-iron retorts or "stills," capable of working some 2000 gallons each at a time. These stills are heated by means of open fires beneath. During the first part of the process permanent gases are given off, while the fluid distillate consists of ammonia, water, and the most volatile constituents of the tar proper. The ammoniacal liquor forms the lower layer, which can be readily separated from the first light oils, which constitute the "crude naphtha" of commerce. The point when the shoot—which conveys the distillate to the receiver—should be changed to another receiver of the distillate is indicated pretty accurately by a "break," or comparative cessation of distillation, together with a peculiar noise known as the "rattles."

On further heating, the distillation recommences, and the "second light oils" come over regularly. The point for again changing the shoot is that at which a sample of the distillate shows a specific gravity of 1.

The next fraction consists of "creosote oils." At first the distillate will solidify in white crystals on cooling, but afterwards a more fluid distillate is obtained, and at a still later stage a drop

or two of the distillate collected on a cold surface (say of stone or iron) will be found to deposit a solid matter, yellow or greenish-yellow in colour, the consistency of butter. The receiver is again changed.

The next fraction of the distillate is rich in "anthracene," which is collected, as far as possible, short of actual coking. The residue consists of "pitch," which is run into closed cooling tanks, and (while still just fluid) thence into large pits provided with concrete bottoms, open to the air, there to solidify. The pitch usually consists of a little more than one-half of the total amount of tar used.

The following Table represents the approximate temperatures, both in Centigrade and Fahrenheit degees, at which the receivers are changed for each fraction :—

Product.	Distilling Pt. ° Centigrade.	Distilling Pt. ° Fahrenheit.
First Light Oils or Crude Naphtha	0 to 110	0 to 250
Second Light Oils or Light Oil .	110 to 170	230 to 338
Creosote Oils	170 to 270	338 to 518
Anthracene Oils	270 to 360	518 to 680
Pitch	—	—

The further treatment of these crude fractions is now proceeded with. The ammoniacal liquor is separated from the "crude naphtha" very easily in a small tank, where, by reason of their different specific gravities, they are divided and run off into separate tanks. The ammoniacal liquor runs to the sulphate of ammonia house, and is there further treated, as will be described under "Sulphate of Ammonia Manufacture." The "crude naphtha" is sold as such to manufacturers, who further treat this with sulphuric acid and caustic soda, and after distilling the product obtain the "benzols," from which numerous medicinal preparations—saccharine, essences, perfumes, antipyrin, etc.—are obtained. These benzols are the great source of the well-known "aniline dyes." Solvent naphtha (used as a solvent, etc., in the rubber and other manufactures), illuminating oil, grease, etc., are also obtained from "crude naphtha."

The second fraction of the distillation, described as "second light oils" or "light oil," is next operated upon in the following manner. Consisting as it does principally of light oils and carbolic acid, the latter is first eliminated by pumping the light-oil fraction into a large horizontal iron boiler lined with lead, which is provided with a mechanical mixer. Caustic soda in certain proportions is now added, and, after the openings are closed, the mixture is thoroughly blended with the mechanical mixer or agitator. After allowing time to settle, the resulting layers of liquid are now drawn off by a convenient system of cocks arranged at different levels on the boiler.

The oils still unacted upon are run to the light-oil refinery, and the combination of the carbolic acid and soda which has been formed is further treated with sulphuric acid, which separates the carbolic acid, and forms with the caustic soda a crude product known as "Glauber's salts" of commerce.

The crude carbolic acid, if intended for rectification, is treated with oxidising substances in order to destroy the impurities, then redistilled and the distillate cooled, and the well-known "crystalline carbolic acid" is obtained. The uncrystallisable liquid portion is drained away, being principally "cresylic acid," and is used for disinfecting purposes. Crude carbolic is widely used in medicinal preparations, for antiseptic purposes, and most of the smokeless powders now in use are manufactured through its agency.

The oils run off from the mixing boiler to the light-oil refinery are rectified first by treatment with strong sulphuric acid, which removes the alkali, and then by distillation the different fractions are taken off as the markets require. The "light oil" contains a considerable portion of benzol and very similar compounds, each or all of which are principally used in the dye industry.

The third fraction of the tar distillation, described as "creosote oils," is now treated. These oils, contained within the store tanks, on cooling deposit a crystallised mass of naphthalene, which is "fished out" with strainers, put into bags, and subjected to hydraulic pressure of about 400 or 500 tons, in order to remove all the remaining traces of oil. The oil flows back by an arrangement of gutters to the "creosote" tanks. This "naphthalene," after removal from the presses and bags, is ready for exportation. It is largely used for "carburetting" gas, the albo-carbon light being an instance of its use, but mostly for the production of

naphthalene dyes and (after purification) for medicines, disinfectants, etc.

The liquid oil remaining in the tanks after the removal of the naphthalene is now treated in exactly a similar manner to the second fraction, the light oil, carbolic and cresylic acid being obtained. The residue from the mixing boiling is "creosote," which is run direct to the store tanks. This is sold principally for the well-known process of creosoting timber as a preservative.

In passing, it may be stated that when coal for the production of steam is high in price, the creosote if low in price (through market fluctuations) can, by an easily adjusted arrangement, be burned in its place, and thus a large saving in expenditure can be effected.

The fourth fraction, after being allowed to cool, and the anthracene having set to the consistency of butter, is now forced by steam pressure into canvas bags, which retain the anthracene and remove most of the oil. This expressed oil flows into store tanks by convenient pipes and gutters, from which it is sold as "Lubricating oil," used for railway waggons and the like.

The bags of anthracene are next placed between cast-iron corrugated plates, these being in couples one above the other, and subjected to a hydraulic pressure of upwards of 300 tons, and under this pressure all the remaining oil exudes. This is run to the lubricating-oil store tanks by means of gutters and pipes. The resulting cakes of "anthracene" are taken out of the press plates and bags and taken to the grinding mills, where they are crushed to a requisite fineness, the powdered anthracene being then rammed into casks ready for exportation. The anthracene, on further manipulation by the buyers, yields the well-known Alizarin dyes, Turkey red, etc. (Centrifugal machines are now largely used to separate anthracene and like substances from the oils which accompany them in their different fractions.)

The fifth fraction obtained—viz., the pitch—is exported to manufacturers of "black varnishes," patent fuel (briquettes), asphalt, roofing felt, etc.

Sulphate of Ammonia Manufacture.

The process of manufacturing sulphate of ammonia, as carried on at most works, is by manipulating the "gas liquor," which is a by-product in the manufacture of coal gas. This is conveyed from the gas works by the same means as the coal tar. It is stored also in the same manner.

From the store tanks the liquor runs to the sulphate house, and is there pumped into the top of a steam-heated ammonia still, constructed of cast-iron, and is allowed to percolate (by a number of ingenious arrangements inside the still) from one chamber to another (these chambers being similar to a series of very shallow drums arranged horizontally upon one another). The stream of liquor is thus constantly met with fresh steam all through its journey, top to bottom. This decomposes the volatile ammoniacal gas contained in the liquor, the remaining combined ammonia being expelled by passing the partly-exhausted liquor into a tank containing milk of lime. The ammoniacal gas resulting from these operations is next passed into the "saturator," an apparatus employed to absorb the ammoniacal vapours by sulphuric acid. This saturator is constructed of wood, lined internally with lead, and provided with a leaden cover, bell-shaped usually. The sulphate of ammonia crystals are formed by the union of the ammoniacal vapours and the acid. These crystals are next "fished out" with long wooden-handled copper scoops and placed on lead-lined draining boards, to be conveyed thence to the store chambers, where soon the crystals dry, losing nearly all their moisture. The chambers are made of wood, with their floors sloping from each side to the centre, where a gutter is usually placed for the extraneous mother-liquor to run, thence to be worked over again. When dry the sulphate is ready to be placed into bags for exportation. It is principally used as an artificial manure.

In the working of the gas liquor, impurities in the form of gases are driven off, consisting mainly of carbonic acid gas and sulphuretted hydrogen. The presence of the latter gas is easily recognised by its disagreeable odour, resembling the smell of rotten eggs. This sulphuretted hydrogen, with all the other gases, is usually conducted through suitable pipes to the pyrites kilns (in works where sulphuric acid is made), there to be ignited. The sulphur contained in the sulphuretted hydrogen forms sulphurous acid gas, thus proving a useful adjunct to the manufacture of sulphuric acid. (Where this is impracticable the gases are generally passed into the nearest convenient boiler to burn them, or the gases are absorbed in iron oxide, which is sold for the sulphur it gains.) The waste liquor, exhausted of its ammonia and gaseous impurities, is run direct from the bottom of the still to the main factory drain.

Sulphuric Acid Manufacture.

Passing from sulphate of ammonia manufacture, sulphuric acid manufacture next comes under consideration. This acid can be made from either brimstone or pyrites (a sulphur ore). Most of the acid is made from the latter, and it is with this process we have to deal.

The pyrites or sulphur ore used is an impure chemical compound, consisting, roughly speaking, of two parts sulphur and one part iron, the impurities being a few other minor metals, with silica, etc., and in some varieties copper is found. The mineral as imported is usually in large lumps, greenish-yellow in colour, and of rather high specific gravity. It is obtained from the mines pretty generally distributed over the world, Spain and Portugal exporting perhaps the greatest quantity. Great Britain and Ireland contribute no mean portion of the world's output.

In a series of closed fire-brick kilns (provided in front with firing doors, ash holes, and openings for the operatives to turn the bars contained within to promote better heat) a fire is started with wood and coke. When a good body of fire is obtained, the sulphur ore (previously crushed in an ordinary crusher to the requisite size of cobbles) is introduced, which on heating soon decomposes, the sulphur burning, and thus forming its own fuel. This sulphur on burning combines with the oxygen of the air to form a gas (sulphurous acid gas), which by means of a common flue connected to each kiln is conveyed through a special kiln arranged at the end of the "set." In this kiln the sulphur gas meets with nitric acid fumes obtained by the action of sulphuric acid upon nitrate of soda, the action being promoted by the heat of the sulphur gas. The reaction is performed in what are technically known as the "nitre pots," these being arranged for withdrawal and recharging at certain periods. The mixture of these two gases now passes into the bottom of a large leaden column erected on a strong base, usually brickwork or masonry, and supported by a framework outside of wooden or iron columns. This column or "tower" is usually about 12 feet square (inside dimension), and about 40 feet high. Inside this tower are arranged alternate layers of flint and coke. This "packing," as it is called, is constantly kept saturated with weak sulphuric acid by means of a distributing apparatus and luting arrangement connected with the supply acid tanks erected at the top of the tower. The nitric acid and sulphurous gases, through chemical

combination, form sulphuric acid gas. This gas as it travels upwards is completely broken up, fresh surfaces being constantly presented to the descending drip and to the wetted sides of the coke and flints, against which the gas is "rubbed" all the way up until it emerges by the outlet at the top. The weak acid absorbs the hot gas to some extent on its journey downwards, and the resulting stronger acid is conveyed by convenient gutters to lead-lined tanks situated at the base of the column or tower. The partially exhausted and somewhat cooled gas is conveyed through the outlet at the top by means of leaden pipes to a series of large "chambers," usually about 100 feet long, 25 feet broad, and 20 feet high. These chambers are generally oblong in shape, and have an outside framework of wood, the inside being made entirely of lead (imported in large sheets, which are unrolled and their projecting edges burnt together), and are erected upon suitable supports some 20 to 30 feet from the ground. Lead is used as the most suitable for the manufacture of sulphuric acid, being but very slightly affected thereby.

The gas, on entry at the first chamber, is met with a certain supply of steam. This immediately absorbs the acid gas, forming weak sulphuric acid. This drops in a constant shower of minute oily drops of liquor to the bottom of the chamber, which at the commencement of the process is covered with a layer of weak acid, and the walls of the chamber dipping into this form a seal which precludes the possibility of gas escaping. The still unexhausted gas is drawn by pressure of steam from the first to the second chamber, and so on through the series (usually three or four). At each exit, from one chamber to another, the gas is less in volume, and the acid formed consequently weaker, till finally at the exit from the last chamber it is drawn through to the chimney shaft, thence to the atmosphere.

The acid formed within the chambers is the "chamber acid" of commerce, which is run off into railway acid tanks (made of iron) or tank barges, and sometimes glass "carboys," and sold according to its specific gravity; the greater the specific gravity the higher the price. This acid is of extreme importance in the arts, and enormous quantities of it are used in the manufacture of "artificial manures." It may truly be said that the manufactures of the whole alkali trades—soda, bleaching powders, etc., etc.—depend mainly on the large amount of sulphuric acid employed. This "chamber acid," on evaporation of the extraneous moisture

and the elimination of the several impurities, forms the "pure oil of vitriol" of commerce, or the "sulphuric acid pure" of the "British Pharmacopœia."

In the combustion of the sulphur ore an ash remains, consisting principally of iron oxides, with small traces of zinc and other metallic oxides, and in the case of cupreous pyrites, copper oxide is also found, and occasionally silver. The burnt ore is therefore a valuable source of these metals, and is exported to various metal refineries for their successful working. The pyrites in their original state could not be worked for these metals. It is only after practically all the sulphur has been burnt out from the ore that it can be worked for its metal, hence it is a valuable by-product.

Artificial Manures.

In passing on to manure works it will be as well to first state the objects of manuring. The object of manuring is to enrich the soil with plant-food. The constituents of plant-food which are naturally derived from the soil are nitrogen, phosphorus, sulphur, potassium, calcium, manganese, and iron, together with the less important constituents—silicon, chlorine, and sodium. A manure will always contain one or more of these substances. Nitrogen, phosphorus, and to a less extent potassium, are by far the most important constituents to be applied as manure, as they are those in which the soil is most deficient. In an efficient manure the constituents of the manure must be in a condition suitable for immediate assimilation by the plant, or at least speedily acquire this condition after mixing with the soil. The term "artificial manures" is understood to include all the manures, save the excrements of animals and the residue of crops, which form the "natural manure" of a farm. It is with the former we have to deal.

Artificial manures may be classed as "general" and "special" manures. The former division embraces those which supply many of the requirements of a crop. They can be used alone, admitting a pretty general application. Special manures, on the other hand, supply few, sometimes but one, of the elements of plant-food, and can only be applied in certain cases.

The warehouses at a manure works contain a general assortment of "raw or unmanufactured manures," and from these stores they are taken to be submitted to processes described

further on. A description of these various and interesting materials and minerals will best preface details of their manufacture. The principal manures usually met with are the following:—

Fish Manure.—This is fish refuse, simply dried and powdered, obtained mainly from Norway and Sweden, the great cod-liver-oil extraction process yielding a large amount of fish refuse.

Guano.—This is formed from the excrement and carcases of sea fowl, and is principally obtained from Peru, Chili, and Patagonia, smaller deposits being found distributed throughout the world.

Damaged oil-cakes or cakes unfit for food (as castor), are employed to a small extent as general manures.

The special manures are a much larger class, embracing nitrogenous, phosphatic, and potash manures, or a combination of any two of these constituents, with other minor substances.

The nitrogenous manures generally used are dried blood, hoofs and horns, shoddy, and wool waste.

Meat meal is now met with. It is the residue from the manufacture of meat extract from South America, Queensland, and New Zealand.

Sodium nitrate, produced by the natural process of nitrification of the soil, is obtained from most of the rainless regions of the world, chiefly from Chili. It is similar in appearance to common salt, and is extremely soluble in water.

Sulphate of Ammonia.—This salt and its manufacture have been described under "Sulphate of Ammonia Manufacture." It is used mainly for its large percentage of nitrogen as an artificial manure.

Sulphate of Potash.—This is obtained from the Stassfurt mines and the surrounding districts, situated in Germany.

Muriate of Potash.—This is obtained from the same districts as sulphate of potash, and it is a very soluble salt of potash. "Kainit," a compound of sulphate of potash, sulphate of magnesia, etc., is also mined at the above places.

Nitrate of potash and various other compounds of potash may sometimes be used. Those whose main constituents are "phosphates" comprise raw bones, steamed or degelatinised bones, and bone ash, together with "phosphatic slag," which is obtained by "Thomas' patent process" for removing phosphorus from pig iron. In the process a large amount of lime is employed, which forms a slag with the phosphorus.

Raw mineral phosphates are, however, the main source of

phosphates. These minerals are distributed throughout the world, the main supply being from the United States—from the South Carolina districts and the large territory of Florida. These phosphates occur in rough masses perforated by boring mollusca, and associated with fossil bones and teeth. They are classed as "land and river" phosphates.

The South Carolina river phosphates are obtained by dredging the Bull, Coosaw, Stono, and Peace rivers. Some of the river phosphates are much smaller and finer than the land phosphates; these are all dried before exportation.

A large supply of phosphates comes from the Belgian and Somme districts. In the north of France and the adjoining borders of Belgium there exists an enormous deposit of friable phosphatic rock extending over 7,000,000 acres. These phosphates are strikingly similar in appearance to fine river sand, and require no grinding for the purpose of manufacture.

A considerable amount of phosphates is now worked in the rock form and exported yearly from Algeria.

In addition to these sources, numberless others far less important are mined for their phosphatic deposits, among others "coprolites." These are generally disposed throughout the world. The coprolites in our own country, now almost disregarded, are worthy of mention. They are said by some to consist of the fossilised bones and excrements of extinct mammals, and are found in the form of "nodules" in the "crag" and other sedimentary rocks of tertiary age, principally in Norfolk, Suffolk, Cambridge, and the eastern counties generally.

The Manufacture of Artificial Manures.

In 1840 a vast industry arose in all countries through a recipe of Liebig's being put into practice for the conversion of bones into soluble phosphatic manure by means of oil of vitriol (sulphuric acid). Therefore the great German chemist, Justus von Liebig, may be called the Father of the present manure trade.

The next important step was made in 1842 by Sir J. B. Lawes patenting a process of converting mineral and other phosphates into soluble forms by means of sulphuric acid, thus originating the well-known "superphosphate" industry.

The handicraft of the manure maker is partly a chemical and partly a mechanical one. The chemical section of the process

comprises the conversion—by the aid of sulphuric acid—of the raw phosphates known as tri-calcium phosphates into "super" or acid phosphates. The mechanical section may be said to consist firstly in such preparatory or preliminary treatment—by suitable reducing or disintegrating machinery—of these tri-calcium phosphates as shall facilitate the exposure to the influence of the acid of their greatest possible surface; and secondly, in the careful and judicious compounding or mixing in proportions of the dissolved or superphosphate with nitrogenous matters and ammoniacal potash, and other alkaline salts as shall be best adapted, in the opinion of the manufacturer, to accomplish the end in view at the price charged.

The chemical reaction of sulphuric acid upon tri-calcium phosphate in its simplest form is expressed in the following manner:—

$$\text{Tri-calcium Phosphate} + \text{Sulphuric Acid} = \text{Gypsum} + \text{Lime Superphosphate.}$$

The sole object of this chemical treatment of the tri-calcium phosphates is that the sulphuric acid should combine with two out of the three equivalents of lime it contains, leaving the whole of the phosphoric acid in combination with the remaining equivalent of lime. This form of phosphate of lime is the acid superphosphate, which, being soluble in water, will permeate the soil, and thus become available to the rootlets of the plant. The raw tri-calcium phosphates are not soluble in water, and are, therefore, not distributed through the soil by rain so as to come within reach of the rootlets of the plant.

Fine grinding of the mineral phosphates is essential in the manufacture of a good quality of superphosphate. It is better for the manufacturer to grind the substances until they will pass through a sieve of at least 60 holes to the linear inch. In the case of very hard phosphates still finer grinding is an advantage.

Among the various machinery and appliances employed in the manure manufactory, the first is that of crushing and grinding phosphates. The phosphate in large or small lumps (as the case may be) is first ground between a large pair of "rolls," fed by means of elevators, resulting in the production of a sample not larger than peas; thence the phosphate is elevated direct to other roller mills for finer production. From these mills the ground phosphate passes into revolving screens of mesh adapted to the variety of phosphate under treatment. The "tailings," emerging from the end of the screens, are returned to the rollers,

each pair of which is equal to an output of 10 to 14 cwt. per hour, according to the refractoriness or otherwise of the phosphate undergoing reduction. The mill-stones are provided with an exhaust fan for keeping the rollers cool, and drawing off the fine particles of phosphate, as produced, into a store-chamber for collection and removal at intervals. The ground phosphates are then introduced from the dissolving loft of the manure works into the "mixer" for treatment with sulphuric acid.

Manure "mixers" are made of various forms and materials, but the increasingly popular form is that with a vertical shaft. Mixers are frequently constructed of wood, lined with lead, but the best are made of cast-iron, lined with bricks. The vertical-shaft mixer is cylindrical in form, being about 4 to 5 feet long, by 6 to 7 feet in diameter; the bottom being convex in shape, to allow of the easy expulsion of each "mixing." The whole "mixer" is made of cast-iron flanged plates bolted together. The shaft is also of cast-iron, excepting the outside end for carrying the driving gear, this being of wrought iron. To the shaft a number of heavy cast-iron "beaters" or arms are secured, arranged spirally. The discharging door is fixed at the bottom or convex portion of the mixer, which consists of a sluice worked by a rack and pinion. The closed top of the mixer is provided with a charging hopper, a gas flue, and an acid-supply pipe, together with "manholes" for the purpose of cleaning out the mixer at intervals. A mixer of the dimensions stated above is easily equal to an output of above 12 tons of "super" per hour; this equals 12 consecutive 1-ton mixings. The superphosphate, as made from the mixing of certain proportions of ground phosphate and sulphuric acid, is discharged through the sluice into the "den" (or receptacle for the "super").

Each mixer is fixed at the roof or top of the "den" (constructed of brick or stone work), which forms a convenient platform on which are stored the raw bones or finely ground phosphates, &c. A pair of gauged acid tanks are also fixed on the same platform, one being filled while the other is being discharged into the mixer. The den is provided with a gas-flue in conjunction with the mixer-flue, these containing the necessary dampers. The common practice is to fill and empty each den on alternate days. The super, when discharged from the mixer, is sufficiently fluid to run pretty evenly over the floor of the den, and in some cases it sets in less than an hour. The whole of the den fronts or "faces" are covered by wooden shutters, arranged for ready removal each time the den is

emptied. These being withdrawn, the den's contents, now a large porous mass, are removed by pick and shovel into barrows or trucks for conveyance to the stores.

The gases evolved in the manufacture of superphosphates, &c., chiefly consist of carbonic and hydrofluoric acids intermingled with steam, together with other minor poisonous impurities, the chief of which is silicon-fluoride. The reaction of the acid and phosphates being rather violent gives rise to considerable heat, and the gases formed (with the exception of the carbonic acid gas) are somewhat irritating to the lungs, and as they come within the Noxious Vapours Act it is essential to avoid their dissemination into the atmosphere. All that is requisite is to pass them through a sufficiently capacious series of depositing flues, tanks, or chambers, arranged with a view to cooling the gases and lowering the vapour tension, and this vapour, through cooling the steam, will condense in the form of moisture, and carry down with it in solution much of the acid gases along with the gelatinous silica.

The remaining imperfectly-purified acid vapours are now passed into towers packed with wood in such a way that the gases travel or percolate in an upward direction. At the summit of each of these towers is a luted arrangement for the continuous moistening of the packing by fine rain-like streams of water, which, as they descend, arrest or collect the foggy vapours travelling upwards, and carry them to the bottom of the towers, which are supplied with a trapped gully connected properly with the factory drain. The purified gases then pass through a chimney into the atmosphere.

For driving the phosphate mills, mixers, &c., high-pressure steam engines with cut-off valves are best for use.

Sometimes it is desirable to treat bones, guano, shoddy, and wool waste, rapeseed refuse, &c., with sulphuric acid to bring their various nitrogenous, phosphatic, and other constituents into a more soluble form; these are, therefore, treated in exactly a similar manner to the raw phosphates.

The manures which have been removed from the dens in lumps are reduced to a fine powder by passing them through revolving screens (provided with beaters) and other disintegrators, and the manures are then placed into bags for the market. It is at this stage that the careful and judicious compounding or mixing of the dissolved super or other compounds with nitrogenous matters and ammoniacal potash and other alkaline salts in proper proportions suitable for the end required is accomplished, special manures for

the different cereals, roots, &c., being manufactured with due regard to the wants of each crop and the deficiency of plant-foods in the various soils.

Fire Risks. Having thus briefly sketched the various processes, the consideration of the fire hazard, from the Fire Offices' point of view, now claims our attention.

In tar distilling, the risk chiefly to be guarded against is that of priming or explosion at the retort or "still" departments. This risk is avoided by careful stoking and applying gradual heats, and by fitting to the stills safety valves of a very low pressure, which at any sign of undue pressure within the stills would warn the operatives, who would immediately draw and extinguish the fires below, and thus obviate any further risk.

Among the various distillates, the naphtha and light oil, being the most inflammable, are conveyed by means of pipes to their underground storage tanks, thus minimising any danger from fire. All other distillates may be left in open tanks, because they, having a greater specific gravity than water, can be covered by surface drainage, rain, &c., and thus be safe from ignition.

In sulphate of ammonia manufacture there is not even the ordinary risk of fire, seeing that steam and gas-liquor only are employed. This latter, indeed, is an excellent fire extinguisher, containing as it does carbonic acid gas and other gases. This liquor, if thrown on a fire, would, by the heat, have all carbonic acid gas and other gases expelled. These gases will not support combustion, and therefore all fire would cease within their influence. Again, in sulphuric acid manufacture, no ordinary risk of fire is run, the contents of the kilns being closed almost entirely, with the exclusion of air in large quantities; the fire, therefore, is of very slow combustion. The acid within the "chambers" would act as a very effective fire extinguisher if the chambers were by any unfortunate accident to catch fire. Wood, or any other combustible, with only traces of acid upon it, makes combustion very difficult.

In the manufacture of manures still less risk of fire is to be feared. In the first place, all the ingredients, with but few exceptions, are incombustible, the only exceptions being the various kinds of shoddy, cake refuse, and, to a very slight extent, raw bones. Their manufacture does not permit of the possibility of fire.

In the grinding at the mills there is not the flour-miller's risk of combustion, seeing that all raw phosphates are absolutely incombustible. The mixing of these ingredients with acid of course obviates any risk of fire, and their subsequent treatment has also no risk.

C. E. TRUFITT.

Norwich Insurance Institute,
November 24, 1896.

A PAPER ON COTTON SPINNING.

(SECOND PART.)

THE first part of this paper* was read at the close of the 1899 Session of the Insurance Institute, and was devoted to tracing the development of raw cotton through its various processes by hand and machinery into yarn, and describing the growth of the industry, the construction and use of the varied and complicated machinery, but avoiding all reference to the Insurance aspect and the fire risk attending the processes incident to cotton spinning, these points being purposely eliminated because the subject had been allocated to our Institute by the Federation of Insurance Institutes of Great Britain and Ireland as one of the papers for publication in the next Federation Journal for educational purposes, and it was accordingly treated on these lines, so that the uninitiated and junior members might have an opportunity of acquiring some knowledge of this important industry.

This technical treatment of the subject, however, is not sufficient in itself, and cannot be considered a complete paper emanating from an Institute located in the centre of the cotton-spinning district, and this second part of the paper will therefore deal with the subject from an Insurance point of view, considering, amongst other things, the importance and volume of the business to Insurance Offices, the fire hazard connected with cotton spinning, together with the causes and fire results of the business over a period of 20 years, and while this will be quite a distinct treatment of the subject, it will form a fitting sequel to the former elementary paper.

Before entering, however, into this Insurance side of cotton mills, it will be advisable to state as clearly as possible, so that there can be no misunderstanding, that the scope of this paper will have to be confined within certain limitations which may be briefly described as follows, viz. :—

**Journal of the Federation of Insurance Institutes of Great Britain and Ireland*, Vol. II., pp. 253–282.

1st. The value of cotton mill property, and its consequent importance to Insurance Offices;
2nd. The principal causes of fires;
3rd. The processes and machines that chiefly contribute to the fires; and finally,
4th. The result of 20 years' fires.

These are the points that will be dealt with, and it will be observed that there will be no reference to or opinions expressed on rates, tariffs, or other matters that belong to or come within the province of the Fire Offices Committee, nor to any of the underlying methods or principles that Offices lay down for themselves in conducting this complicated and anxious business, which calls forth the best energies and intelligence of the Insurance expert to keep a watch on the ever-changing character of the hazard arising out of the manipulation of raw cotton into yarn.

The Value of Cotton Mill Property.

The capital invested in the building and contents of cotton mills in Great Britain is approximately estimated by competent authorities at about £45,000,000, plus working capital, which will bring the total investment to £54,000,000, and the seat of this trade is in the Lancashire district.

This large amount of insurable property is of great importance to Fire Insurance Companies, and has naturally great attractions for all Companies operating in the district owing to the large revenue derivable from the business, hence there is keen competition and rivalry to secure the largest possible share; but to the experienced underwriter the volume of premium obtained is always received with mingled feelings from the fact that his experience brings up to his view the fire hazard arising from so many causes incident to the business, and which we will now consider in detail.

Fires and their Causes.

Cotton mill fires are both numerous and disastrous in their results, and it is not difficult to account for this when it is remembered that cotton is a light vegetable fibre, very inflammable, and manipulated by rapidly-revolving machinery, generating great friction, and as this friction is the chief factor in fires, we shall deal with it as fully as possible; but as there are other causes of fires, a reference to the records of the last twenty

1891.	1892.	1893.	Five Years.	1894.	1895.	1896.	1897.	1898.	Five Years.	Total 20 Years.
45	20	18	144	18	25	19	16	25	103	434
...	...	...	1	...	...	...	...	...	...	1
21	14	13	65	7	10	12	6	15	50	151
2	1	...	5	...	...	1	1	...	2	8
1	...	...	5	...	1	...	...	...	1	15
3	1	...	8	...	1	1	...	..	2	27
...	...	1	1	...	...	...	...	...	...	1
...	...	...	1	1	...	...	...	...	1	3
1	...	...	1	...	1	...	1	...	2	6
...	...	...	1	...	...	1	...	3	4	7
...	...	...	1	...	1	1	...	2	4	5
1	...	...	1	...	...	...	...	...	...	1
2	...	...	2	...	...	...	..	...	...	4
...	...	...	...	...	...	...	...	...	...	2
...	...	...	1	...	...	...	...	...	...	1
2	...	...	3	...	...	...	...	...	...	15
3	...	...	4	...	...	...	...	...	...	12
1	...	...	2	...	...	...	...	...	...	2
2	...	...	4	...	...	...	...	...	...	5
...	...	...	...	...	...	...	...	...	...	3
...	...	...	...	...	...	...	...	...	...	1
...	...	...	...	...	...	...	1	...	1	1
1	...	...	1	...	...	...	...	...	...	1
...	...	...	...	...	...	...	...	...	...	1
...	...	...	...	...	...	...	...	...	...	1
...	...	1	1	...	...	...	...	...	...	3
18	11	2	56	6	3	5	6	6	26	211
12	13	8	49	12	2	2	3	4	23	74
115	60	43	357	44	44	42	34	55	219	996

years' experience may be interesting and instructive, and the preceding table contains all the information available on this important point.

This statement shows that there have been 996 fires during the period under review, and, according to the classification, the causes incident to the physical hazard of the trade, and extraneous causes, are as follows, viz. :—

Friction, ...	59·6	per cent.
Gas Lighting and Cotton in Contact with Gas, ...	4·3	„
Spontaneous Combustion, ...	1·5	„
Matches in Cotton, ...	1·2	„
Millwrights, &c., Working, ...	1·0	„
Unknown, Ordinary Mills, ...	20·2	„
„ Sprinklered Mills, . . .	7·4	„
Various General Causes not connected with Spinning, ...	4·8	„
	100·0	

Dealing with these causes in their order, it will be observed that more than one-half the total number of fires are through friction, which term embraces losses through hard substances in cotton, striking of bevel wheels, overheating of shafting, tin rollers, and the head-stocks of mules; hard substances in cotton and the friction in mule head-stocks being the two largest contributors under this head. Lighting with gas has been a fruitful source of fire, 4·3 per cent., but this cause is fortunately diminishing owing to improvements in the method of lighting the mule spinning rooms. Formerly the gas lights in mules were fixed in the creels at the back of the mules, and in lighting up it was not at all an uncommon occurrence for the lamp to fall into the creel through the attendant tripping over the mule carriage rails, and a fire was the result, but the gas lights are now chiefly fixed down the "aisles" of the mule way and consequently free from the old danger, and a further improvement in this respect is the introduction of the electric light, and, so far as we have been able to ascertain, there has only been *one fire* through a defective electric light installation in these mills.

The unknown causes amount to 27·6 per cent. of the total losses, and it is very unsatisfactory that so large a number of fires cannot be traced and classified; but as many fires occur after the mills have ceased working, with no one to witness the commence-

ment, it will be readily appreciated that it is almost impossible to trace the cause, and we shall always be liable to these "unknown" causes.

These three sources of fires make up 82·5 per cent. of the total fires, and the remaining 17·5 per cent. are from various accidental causes not incident to the business, and therefore do not call for special reference, except to notice that the old bugbear "spontaneous combustion" is almost absent, and that "incendiarism" is also missing in the statement of fires, there being only three cases of "suspicion" during the twenty years, but no actual proof, so that, giving this cause the benefit of the doubt, it is satisfactory to record that "moral hazard" does not enter into cotton mill fires, so far as accountable losses can be traced.

The Processes and Machinery that chiefly contribute to Mill Fires.

"Friction," as already stated, is the cause of the largest number of fires, and it is from the machinery and shafting that this friction arises, commencing in the blowing machinery and intensified in the mules.

Blowing-room fires are chiefly caused through the cotton containing hard substances, consisting of small pieces of iron, stones, sand, and other foreign matter (as fully explained in the first part of this paper) which find their way into the cotton either before packing or during the process of mixing, and these substances passing along with the cotton into the opening or blowing machinery come into contact with the revolving beaters of these machines, causing sparks to be struck, and the loose cotton is immediately ignited and a large or small fire results, according to the quantity of cotton in the compartment. The extent of these fires has been considerably reduced of late years through penalising the mixing and blowing processes when done in one compartment, with the result that these two processes are now largely carried on in separate compartments, so that when a fire occurs in an opening machine it is confined to the cotton passing through the machine and that immediately around it.

The introduction of bale breakers or cotton-pulling machines, and also of porcupine feeders for opening out the cotton and removing a good deal of the sand and other "hard substances," has largely reduced the risk of friction, but there is still room for improvement, either in more perfect cleaning machinery or in the method of packing and baling the cotton, and it is to the latter

process that we must look for a consummation of what we desire —cotton free from dangerous "hard substances."

An attempt in this direction is being made by two American companies who are baling cotton in a form known as "cylindrical bales"; one kind is called the "round bale" and the other the "Lowry bale." Amongst the many advantages claimed for the "Lowry" method of baling is that the cotton passes direct from the ginning process to the bale press, and when the bale is removed it is held against expansion by four galvanised iron tie wires about the gauge of telegraph wires, which are the only ties necessary to hold the bales in shape. The covering for these bales consists of a cotton bag with puckering strings at each end, which are drawn together when the bag is placed over the bale, and it is then ready for despatch from the ginning factory without further handling, and reaches the mill in a cleaner and better condition as to packing than in the old system of baling. We have no personal knowledge of the "Lowry" process, but we can quite appreciate that the cotton from these bales ought to have the effect of reducing the cause of fires in blowing-houses, owing to its cleaner condition, due to the direct packing from the ginning boxes and the absence of iron bands and rivets with which the present square bales are bound; and though we have no experience on the point at present, the new baling should produce a marked improvement in the near future.

Passing from the blowing, etc., houses, we find that the largest number of friction fires occur in the mule spinning rooms—the carding, roving, and drawing machinery contributing very few, if any, from this cause, owing chiefly to the comparatively slow motion of this machinery, and also from the fact that this class of machinery is constructed principally of ironwork. The "mules" are the reverse of all this, being mainly constructed of light wood and the spindles worked at a high rate of speed, making 9000 to 10,000 revolutions per minute; so that, if lubrication is neglected, friction is set up, and fire is the result. There are two parts of a "mule" where this danger is the greatest—the "head-stock" and the "tin roller." The "head-stock" is the driving power of the mule, and contains four pulleys fixed within a few inches of the floor, making differential speeds from 800 to 1000 revolutions per minute, and these pulleys have contributed more fires than any other part of spinning machinery, owing partly to want of some method of automatic lubrication, and partly from the great weight

they have to move—the mule carriages containing from 1200 to 1300 spindles, and the longer the mules the greater strain and friction on these pulleys, and the neglect of systematic lubricating of these high-speed pulleys will cause them to strike, or run hot, and throw off sparks on to particles of cotton that hang to the machinery, or into the mule carriage by means of the rope driving bands that are constantly passing over the pulleys. This friction might be reduced and the fires minimised by fixing lubricating cups to supply oil to the bearings; and although we are aware that this would be a difficult thing to do, it is a problem for the machinist to overcome, and until some such improvement is effected there will be no freedom from fires in "headstocks."

The next largest source of fires from friction is to be found in the "tin roller" which is fixed in the centre of the mule carriage and extends the whole length of the mule, revolving at a speed of 1000 to 1200 revolutions per minute. These rollers are for turning the spindles, and are supported on bearings inside the carriage imperfectly provided with means of lubrication. These bearings consequently often heat through want of oiling, or from the rollers running unevenly, and the carriage being constructed of light wood and always more or less charged with oil and fluff, a fire is the result, and rapidly extends through the whole of the carriage, often ending with the destruction of the mill. This cause of fire becomes so serious as to call special attention to the defects in the lubricating of the bearings of these rollers, and for some years past all new mules have fixed iron lubricating cups attached thereto to be filled with tallow, and no mules are safe from friction fires unless they are so fitted. At the same time this precaution is not infallible, as it depends upon good management to ensure these cups being regularly filled and in working order.

Another source of friction fires is from shafting and gearing for driving the machinery, which is more frequent from the latter than the former—the gearing being the bevel and cog wheels which carry the driving power from the engine to the shafting in each room of a mill; and these fires may occur in any part of the premises from too much strain or weight being put on the gearing, or, in other words, by increasing the speed beyond what it is calculated to carry; and when this occurs one of two things is sure to happen—either some of the teeth of the wheels will break

under the pressure, or they will strike fire and throw off sparks, igniting the oil and fluff in the wheel-boxes in which these wheels are enclosed; and owing to this cause of fire wood wheel-boxes should never be allowed, but only metal coverings, which serve to check these fires.

The new system of driving by belts and ropes instead of by gearing has reduced this hazard, and with the extension of this new driving power, and the discontinuance of gearing and bevel wheels, friction fires from this source will be considerably reduced.

In addition to fires from friction and other reasons, there is yet another cause which cannot very well be classified, though it contributes to "friction" and some of the other fires—namely, want of cleanliness. It is rather difficult to define "cleanliness" in a cotton mill, but an experienced eye can detect at once the difference between a well-managed mill and a badly-managed one by, amongst other things, the absence of any fluff or fly arising from the various processes adhering to the machinery, shafting, or piping. No fly should be allowed to accumulate, for there is always the probability of it getting upon the working parts of the machinery containing oil, which it absorbs, and becomes oily waste, and fills in and clogs the clear working of bearings and other working parts, creating friction, heating, and fire; and when it is remembered the high speed at which machinery is worked both in blowing-rooms and spinning-rooms, it is essential for the prevention of fire that the greatest cleanliness should be observed and all the working parts kept free from fly or fluff; and if the machinery was thus kept clean and properly oiled there would be a considerable diminution in the number of fires.

Lubricating oils bear a very important part in considering friction fires; but the question is a very vexed one, and as it was treated in a very able paper by Mr. G. H. Hurst, F.C.S., read before the Insurance Institute in Session 1897-8, we do not propose to deal with the question here, except to remark, in passing, that cotton machinery requires a lubricant possessing two important qualities—one being a suitable and free lubricant for high-speed machinery, and the other that it shall not be liable to oxidisation in the hot rooms of the mills.

We have dealt with the causes of fires at as great a length as the time at our disposal will allow, and an examination of the results of fires during the last 20 years—1879 to 1898—would be

an interesting study, to ascertain whether there is the same fire waste occurring now as in the earlier portion of this period; and from our own study of the subject we have been forced to the conclusion that consequent upon improvements that have been made in many directions, and which we shall endeavour to indicate hereafter, the severity of fires has been reduced in this important branch of Insurance business.

Time will not permit us to give here a tabulated statement of the losses that have occurred in each year of the 20 years under review, but, briefly, we may state that in this period there have been 996 fires, involving a total loss of £3,072,112, which gives an average loss for each fire of £3423; but in the earlier portion of this time—1879 to 1883—the percentage of loss to the number of fires was nearly double this amount, and in the latter portion —1894 to 1898—it was considerably less, notwithstanding that there were 3,386,664 more spindles at work in Lancashire in 1898 than existed in 1883. This very favourable result demonstrates very clearly that there has been a great check on the fire waste in these mills during the 20 years under review, and the fact that fires do not decrease in *number*, but in the *extent* of the losses, points to some steady improvement in the fire hazard, and this is the gratifying conclusion that we wish to enforce.

Before concluding this paper, we should wish as far as possible to trace the improvements which in our opinion have reduced this loss ratio, but we give them under reserve, and merely for what they may be worth in this connection, in the following order, viz.:—

The improved state in which cotton now arrives at the mills.

The introduction of better cleaning machinery in the blowing-houses.

The separation of blowing and mixing compartments.

The erection of new spinning machinery specially constructed to stand the strain of "high speed."

The substitution of belt or rope driving for gearing.

The introduction of electric lighting and alteration of gas lights in mule-rooms.

The improvement in lubricating oils.

The fitting of extinguishing appliances; and lastly, but one of the most important, is the introduction of automatic sprinklers, which have undoubtedly been of great service in coping with and checking outbreaks of fire.

These are some of the points which we think may account for the betterment, but there are doubtless others, and we had hoped to have included fireproof mills as another cause, but with the increasing loss ratio amongst these mills we are forced for the present to leave out fireproof mills as a factor in decreasing the fire waste.

Although so much has been done to reduce the fire hazard in cotton mills, there still remains the risk of the "mules" and "head-stocks" to be lessened. We have indicated how the friction in the "head-stocks" might be reduced, and we think the rapid spread of fire on the mule carriage might be checked if the inside were painted with asbestos paint and divided into partitions by sheet-iron plates at intervals, both of which could be done without detriment to the working; and although there is an old axiom that "It is not the business of Insurance Companies to put out fires," still it is very desirable that any intelligent and practical suggestion that can be made with the view of checking abnormal losses is in the best interests of both the Insurance Companies and their clients.

THOMAS A. BENTLEY.

Manchester Insurance Institute,
December 18, 1899.

GASWORKS

PART I.

In an old dictionary I possess, gas is given as "a spirit not capable of being coagulated, or the most subtle and volatile parts of anything," and the assumption that the word has sprung from, or been suggested by, the Dutch "geest," meaning spirit or ghost, seems to me a very reasonable one, as the feeling of responsibility created when I agreed to attempt the preparation of a paper on the subject at short notice has increased and haunted me more and more as the matter has developed itself.

To one of a sanguine temperament it might momentarily have seemed that the call for such a paper would be removed ere it was due for delivery, as about the time the subject was last before your Committee there appeared an announcement in the press of what promised to be an epoch-making departure in connection with artificial lighting, from which I will venture to read you an excerpt:—

> "Catch your bacteria and soak them in the right liquid; "put the liquid in bottles and there you are!
>
> "The most malignant bacteria—if they happen to be "phosphorescent as well—will, after being soaked in "the right kinds of liquid, produce a light that is as "clear as sunlight and as soft as moonlight.
>
> "It contains water, sea water, one ternary compound, one "nitrogenous compound, one phosphate, and traces of "mineral compounds. The best results are obtained by "using glycerine and mannite among the tenary com-"pounds, peptones among the quaternary compounds, "and among the phosphates, nuclein, lecithin, and "neutral potassium phosphate.
>
> "These, suspended from the ceiling, supply a clear, delicate "glow that transforms the most hopeless room and makes "the dullest complexion brilliant."

I need hardly tell you that the announcement appeared in an American paper, nor that any bright hopes induced by this promised brilliant illuminant have long since faded away, and we must perforce leave the bottle and the bacteria in the hands of our imaginative and inventive American cousins for further development. By the way, I learn that the supply of natural gas in America is rapidly diminishing, which is perhaps not surprising when it is noted that the estimated consumption last year was 108,000,000,000 cubic feet.

The credit for making gas as a practical illuminant rests with William Murdoch, an Ayrshire man, at a time when he was residing in Cornwall, the first business premises into which it was introduced being apparently Messrs. Boulton & Watt's Engine Works at Birmingham in 1798. But although Murdoch was first in the field, after experimenting for some five years, the introduction of gas in London was due to a Mr. Winsor, who had seen the results produced in Paris by Lebon, a French chemist, which he referred to as "the wondrous effects of common smoke being made to burn with greater beauty and brilliancy than wax or oil." (I can quite imagine such a remark being made by anyone seeing for the first time unpurified gas in combustion.) Winsor returned to his home in Belgium, assiduously studied gas-making himself, and in 1804 came to London and exhibited at the Lyceum Theatre the phenomenon of gas illumination, apparently in entire ignorance of Murdoch's successes in the same direction. The opposition shown to the endeavours then made to establish an undertaking for public lighting was pronounced. Not only was the development an entirely new and startling one, but vested interests were touched, and the arguments for and against any change were numerous, and at times particularly absurd. One on record is that "the oil fisheries are the nurseries of our seamen. Where will England's glory go if we give up oil and burn coal gas? No wonder that a Frenchman has come amongst us to try to get support to his designs. Burn gas and England's naval supremacy is gone for ever." It must be remembered that this was just after Trafalgar had been won, which perhaps partially accounts for the trend of the argument. Winsor, however, was not a Frenchman, but either a German or a Belgian. It was therefore not until 1810 that the London and Westminster Gas Light and Coke Company was formed, the forerunner of the numerous gas undertakings we have round us to-day.

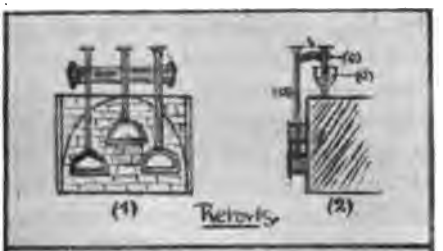
These fascinating highways and byways of the past must not, however, be explored this evening, and I must only add that gas lighting became fairly general between 1816 and 1820, and that our Newcastle streets were first so illuminated in 1818.

To-day the authorised capital of gas undertakings in the United Kingdom exceeds £114,000,000. A year's production of coal and water gas is in round figures 147,000,000,000 cubic feet, over 13,000,000 tons of coal being carbonised for the purpose. The number of gas consumers exceeds 3,485,000. Over 26,000 miles of gas mains are now laid, and the number of public lamps exceeds 581,000. Astonishing as these figures may appear, they would doubtless all require increasing if we came to consider the question twelve months hence.

PART II.

Turning to the manufacture of coal gas, I have thought that a panoramic presentment of the principal plant required in gas-making would be a desirable preliminary to dealing with the matter in detail, and, as a needful appendix to the sketches, the office each piece of plant performs is roughly outlined. Our attention must first be given to the

Retorts, which are of many types, but in all cases are of necessity strongly built, and constructed solely of non-combustible materials. The retort itself may be of fire-clay, fire-bricks, or segments (the advantage claimed for the two latter modes of construction being that any defective brick or segment can be replaced without renewing the whole retort). The only ironwork is the mouth-pieces and doors (which latter are tight fitting or luted), and, of course, the pipes through which the gas passes from the retorts. Fire-bricks, blocks, and tiles comprise the materials from which their settings are constructed, the whole bench being braced with iron. Retorts are of various sections—round, oval, and "D" shaped, the latter shape being largely adopted. A range of retorts is known as a bench, and each group is spoken of as the "bed" or "setting." Any number of retorts up to nine may be found in a single setting. Retorts having only one mouthpiece

PLANT.	PROCESSES.
	Retorts. (1) In which Coal is distilled. Retorts. (2) Side view . . . showing (*a*) Ascension pipe (*b*) Bridge pipe (*c*) Dip pipe (*d*) Hydraulic main, through which "raw" gas passes from Retorts.
	In Hydraulic main, Foul main, and Condensers, Tar (*i.e.*, oils and solid substances) and a small percentage of Ammoniacal liquour are separated.
	In Washer the remainder of Tar and some of Sulphur impurities and Carbonic Acid are separated.
	In Scrubbers the remainder (bulk) of Ammoniacal liquor, and a further portion of Sulphur impurities and Carbonic Acid are separated.
	In Purifiers the main portion (about 50°/₀) of Sulphur impurities and Carbonic Acid are arrested.
	Water Gas is lodged in a separate holder after manufacture, but joined in one main with coal gas and carried to a single holder before passing to the Town's distributing main.

for charging and drawing are known as "single," and those having mouthpieces on both sides of the bench as "through" or "double" retorts. These two classes are respectively of about 9 and 18 feet in length, bnt there seems no fixed standard, and I have found a great many different lengths in use. At one time retorts were all horizontal, but now inclined retorts are coming into use, and offer important advantages in the easy and mechanical handling of the material, being charged at the top end from one side the bench, and drawn at the bottom end on the other side of the bench. They are erected at a special angle of inclination based on the known angle of repose or rest of coal (this angle varies somewhat according to the class of coal), and the idea that the charge would all settle at the lower end of the retort, which may at first thought appear probable, is a fallacious one, as the coal spreads itself automatically throughout the retort. The retort opening is slightly wider at the bottom than at the top, and I have had the following dimensions given me:—Length 20 feet or slightly longer, top opening 20 inches by 15 inches, bottom 24 inches by 16 inches; but these retorts vary in length from about 12 feet upwards. Figures 1 and 2 illustrate a retort house and bench, showing the stage floor (for charging and drawing retorts) and subway.

Firing of Retorts.

Direct Firing.—In small gasworks, or, indeed, in large ones of some age, direct firing may be the method employed, there being an oven or furnace to each bed of retorts, but gaseous firing is steadily becoming more general, on the generator or regenerator principle.

Generator Settings.

In case of generator settings there is a series of horizontal flues up either side of the furnace, backwards and forwards through which secondary air passes, and is gradually warmed through the walls of the furnace. Steam and primary air pass through the incandescent coke in the furnace, and the producer gas (carbonic oxide gas) thus generated in the furnace, and the heated air in the side flues, join in a chamber (above the furnace), where combustion takes place (combustion chamber), and the hot gases circulate through the passages round the retorts, the waste gases finally passing off through main flue to chimney.

Regenerator Settings. In regenerator settings there are two sets of flues on either side of the furnace, and after the hot gases have circulated round the retorts the waste heat is brought back and carried down through (usually) the outer set of flues (before passing to the flue to main chimney), thus heating in their progress the secondary air (required for combustion), which rises through the inside set of flues and joins the producer gas in the combustion chamber. By this method of heating a through bed of retorts may be served by one furnace, or each side may have its own furnace.

The furnaces are fed from the hot coke as drawn from the retorts, a mouthpiece for feeding being provided on the level of the retort drawing floor (stage or charging floor), the furnaces being periodically cleared of clinker, ashes, etc., by means of a clinkering door opening on to the "subway" (often, however, on ground level) found in all modern retort houses. Into the subway also the incandescent coke as drawn from the retorts falls through an opening in front of the settings. In the old style retort houses the coke is drawn into iron barrows on the charging floor level. The coke is partially quenched by water prior to removal from retort house.

I have simply touched the fringe of the subject in these details, the question of firing being a very important one from the gas engineer's standpoint, but I think for our present purpose this brevity may be excused.

The time required to attain the desired temperature in a setting averages about two days. The process is a gradual one, as sudden changes in temperature are very detrimental, indeed destructive, to settings.

It should be mentioned that in some small gasworks, where gas making is not carried on continuously, iron retorts are used, being more readily heated and less susceptible to damage from the causes just named.

Distillation. Coal gas is produced by the destructive distillation of dry coal in the retorts just described, which are heated to a temperature of 2000 to 2500 deg. Fah. The coal used is usually in small pieces, and during the process, which lasts from four to six hours, gas coal agglutinates, *i.e.*, in a sense boils, thus forming a soft,

spongy mass; whilst cannel coal (the consumption of which is relatively small and declining) decrepitates, *i.e.*, breaks to fragments; all that is volatile in the mineral at the temperature reached passing off, and the solid matter left when drawn from the retorts breaks into the irregular lumps or blocks with which we are all familiar under the name of coke. A charge in a through retort reaches up to 8 cwt. o coal.

The distilled product (raw gas) contains in addition to gas a large number of constituents, comprising coal tar, which, on distillation, yields, broadly speaking, creosote, anthracene, and light oils and crude naphtha, and a residuum of pitch; ammoniacal liquor, from which sulphate of ammonia is produced; carbonic acid, sulphuretted hydrogen, and bi-sulphide of carbon. So far as possible, all these bye-products require separating from the gas, and it is with this object in view that, following distillation, the gas passes through the hydraulic main, condensers, washers, scrubbers, and purifiers. The tar and ammoniacal liquor recovered during the passage of the gas through the condensers, washers, and scrubbers (the hydraulic main will be referred to later) pass off from each either into boxes, syphon pots, or overflow syphons, specially provided in connection with the respective pieces of plant, and then forward through piping to the tar and liquor wells or store tanks, all pipes being sealed in liquor to prevent the escape of gas.* The gas passes on from one piece of plant to another through underground piping. These general features are mentioned here in order to prevent undue repetition as we deal with the processes seriatim.

The distilled product passes from the retorts through an ascending pipe to a short bridge pipe (usually horizontal, sometimes slanting, sometimes curved), then through a short dip pipe, which vents into a hydraulic main. This arrangement is duplicated on either side of the bench in case of through horizontal retorts (almost universally), but from inclined retorts the gas makes its exit through a similar set of pipes at the bottom end only of retorts. The hydraulic main is a horizontal U, round, or "ᗡ" shaped pipe running above and parallel with the edges of the retort bench. It is filled to a certain level with ammoniacal liquor, and has sometimes two overflow pipes at different levels, the lower one for tar, and the upper for gas and ammoniacal

* Tar separators are sometimes provided at different points, which divide the tar and liquor before they pass to the wells or tanks.

liquor, or often only one overflow pipe is provided, the liquid being run off with the gas, passing off (by gravity) at an early point through a pipe which taps the foul main. The dip pipe (before mentioned) is slightly below the liquid, thus forming a seal, which prevents the escape of gas back into retorts after it has once forced the seal, and as the distilled matter passes through the hydraulic main a cooling process, which has commenced in the connecting pipes, is continued (the temperature of the gas here is about 150 deg. Fah.), consequently tar is deposited and other liquids are condensed. These products pass off in one or other of the ways named, and travel on to the tar and liquor wells or to store tanks, whilst the gas moves forward through horizontal piping (foul main), where cooling and condensing still proceed until it reaches the

Condensers. Of these there are several kinds. A very simple and familiar type consists of a series of vertical iron tubes in which the gas alternately ascends and descends, being cooled by the action of the atmospheric temperature or by water run over the outside of the tubes. (This type is illustrated in Fig. 3.) Sometimes these tubes are arranged horizontally. Annular condensers (Fig. 4) are now numerous. These consist of a number of columns, each formed by two tubes concentrically arranged, the gas passing through the space between the inner and outer tubes, whilst cool air ascends the centre space. Short arms connect the columns at top and bottom alternately, through which the gas passes from one column to another. The "Standard" Battery condensers are another type, which consist of vessels or boxes, constructed in superposed sections, each section fitted with water pipes. The water moves through these pipes, and the gas travels between them. Water or weak liquor is also allowed to trickle over the outside of the pipes, so that a scrubbing process takes place in these vessels as well as condensing.

The bulk of the tar remaining is arrested by the condensers, and some small amount of ammonia.

Exhausters. At this point the exhauster takes its place for drawing the gas from the hydraulic main and through the condensers, and driving it forward through the remaining plant into the gas-holder. Various kinds of rotary and pump exhausters are in use of most clever arrange-

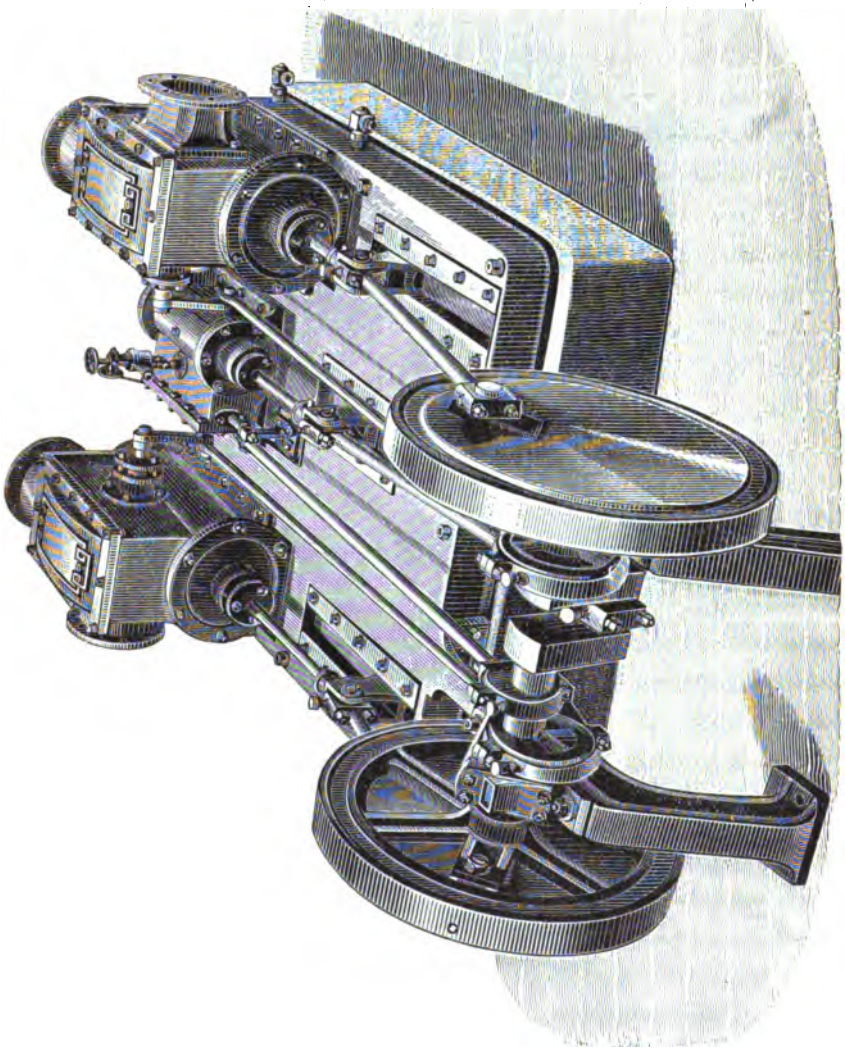


Figure 5. Reciprocating Pump Exhauster. (R. & J. Dempster, Ltd., Manchester.)

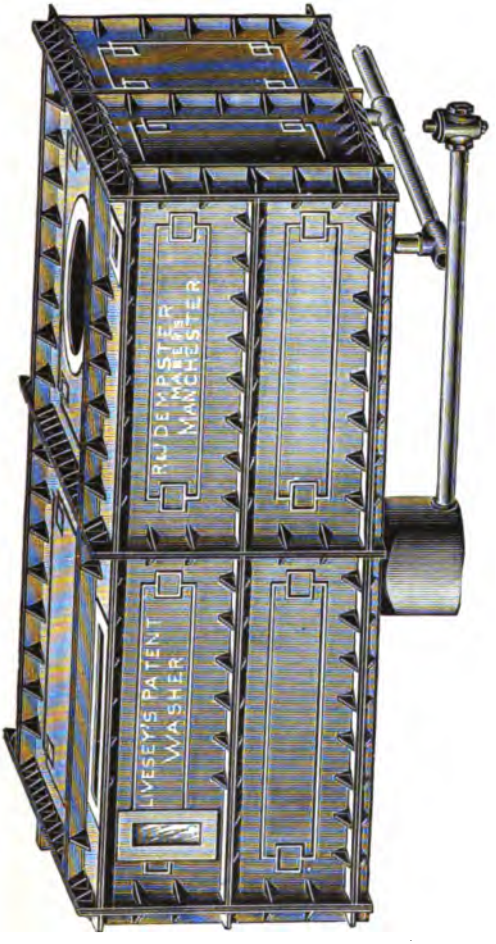


Figure 6. "Livesey" Washer. (R. & J. Dempster, Ltd., Manchester.)

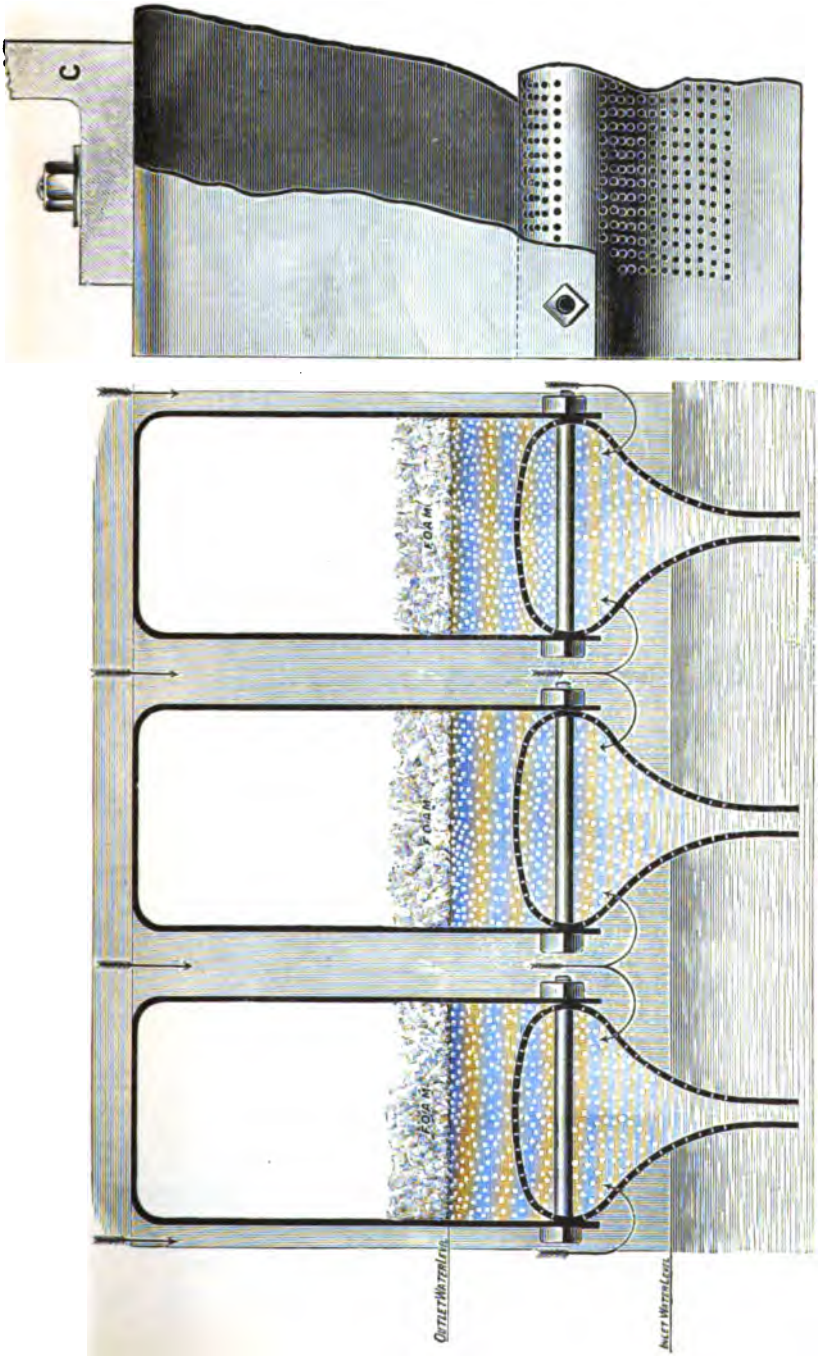


Figure 7. Enlarged Section of "Livesey" Tubes. (R. & J. Dempster, Ltd., Manchester.)

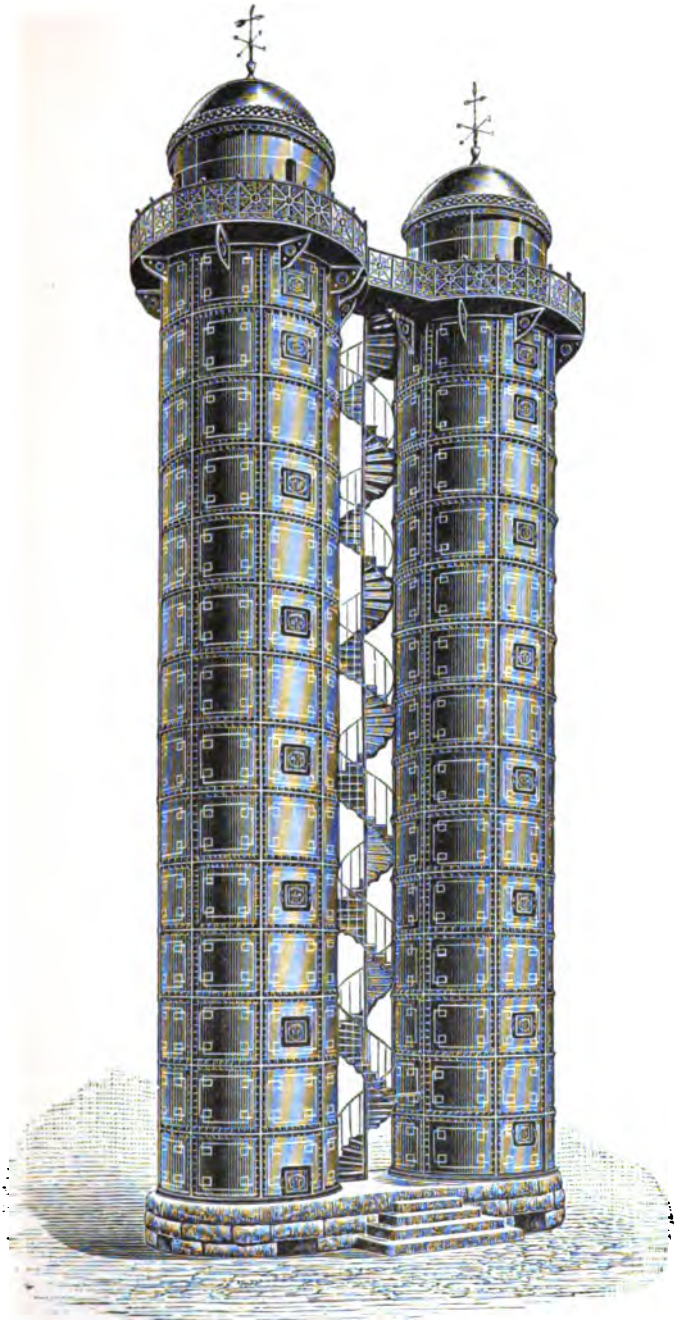


Figure 8. Tower Scrubbers. (R. & J. Dempster, Ltd., Manchester).

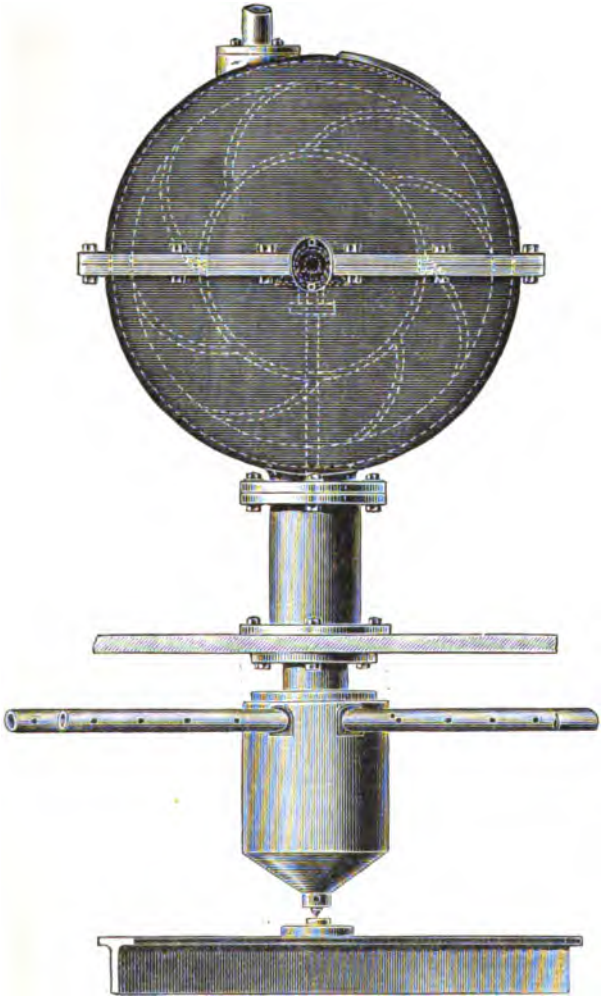


Figure 9. LIQUOR DISTRIBUTOR FOR SCRUBBER TOWER.

(R. & J. Dempster, Ltd., Manchester.)

ment, the suction and driving influence being necessarily of quite different powers, and a governor is requisitioned which regulates the speed of the engine working the exhausters. Fig. 5 illustrates a reciprocating pump exhauster consisting of two double-acting horizontal pumps with steam engine between for driving.

Washers. The cooled gas next reaches the washers, externally simply iron boxes or vessels, in which in a fine spray or stream it is passed through water or liquor. Fig. 6 shows a "Livesey" washer, in which the desired object of sub-dividing the gas into minute bubbles in contact with liquor is attained in the fullest degree by means of perforated iron plates through which the gas passes, the holes being one-twentieth of an inch in diameter, and there are about thirty of these in a superficial inch of plate. Fig. 7 gives an enlarged section of the "Livesey" tubes, the flow of the gas being indicated by the arrows. The gas passes through two sets of perforations before reaching the interior of tube previous to leaving the washer, and is shown bubbling through on top of liquor.

Strong ammoniacal liquor, *i.e.*, liquor which has done service in the scrubbers is used in washers, and here the whole of the tar remaining in the gas is removed, a large part of the ammonia, and about 25 per cent. of the sulphur impurities (sulphuretted hydrogen and bi-sulphide of carbon), and carbonic acid.

Scrubbers. These are metal columns (Fig. 8) of various heights filled with either coke, tiles, broken bricks, or fitted with deal boards of different widths. The coke, etc., or boards, as the case may be (boards, I think, predominate), form the scrubbing surfaces over which the gas (after coming from washers) slowly passes upwards, a supply of liquor coming downwards. When only one scrubber is provided, water is fed in at one point and ammoniacal liquor at another, but in large works they are used in pairs or series. Ammoniacal liquor will then be passed through one and clean water through another. (A washer is often found fitted at the base of and under the scrubber tower.) The gas, on nearing the top of the tower, usually passes into a descending take-off pipe in the centre, and is thus conveyed to the next scrubber. (Sometimes these pipes are arranged outside the

tower.) The take-off pipe is protected from the entrance of liquor by a circular plate above it.

Many clever devices are in use for supplying the liquor in regulated quantities to the scrubber, contained in what is called the machinery room at the top of tower. The liquor distributor (Fig. 9) is one of these. The liquor falls into the buckets of a water-wheel, which turns a vertical shaft by means of a pair of bevel wheels. This shaft is connected to the receiver which carries the distributing arms, automatically driving the latter at a slow speed. The liquor runs into the receiver, and from there flows out through the perforated distributing arms in a continuous spray over the whole area of the scrubber.

The "Standard" is another form of scrubber, being a rectangular vessel constructed in superposed sections, each section fitted with a large number of indented iron sheets (slightly immersed in liquor), which form the scrubbing surfaces. From an inlet chamber the gas enters the lowest scrubber, travels downwards and then works up through the liquor, passing from chamber to chamber and repeating the process in each.

The object of scrubbing is to remove all ammoniacal liquor remaining in the gas, and part of the suphur impurities and carbonic acid are also drawn off.

Washer-Scrubbers. These are now coming commonly into use. The "Standard" machine (Fig 10) consists of a cast-iron cylindrical body, with shaft passing through centre, attached to which are discs constructed of outer iron plates and inner wooden boards, kept apart by deflecting strips of wood. This shaft revolves very slowly, driven by a small engine connected with the machine, and the discs pass through ammoniacal liquor which partly fills the chambers into which the cylinder is divided. The gas enters at one end, passes through the discs, and out at the other, the liquor moving through in the opposite direction and being at graduated levels throughout the machine.

The "New" scrubber-washer (W. C. Holmes & Co.) is another popular rotary machine, which is fitted with discs studded with clusters of fibre, forming flat circular brushes, which press against the sectional divisions in the scrubber, and the gas in its passage through the machine is forced to make its way between these fibres, thus being divided, so to speak, into minute particles. The

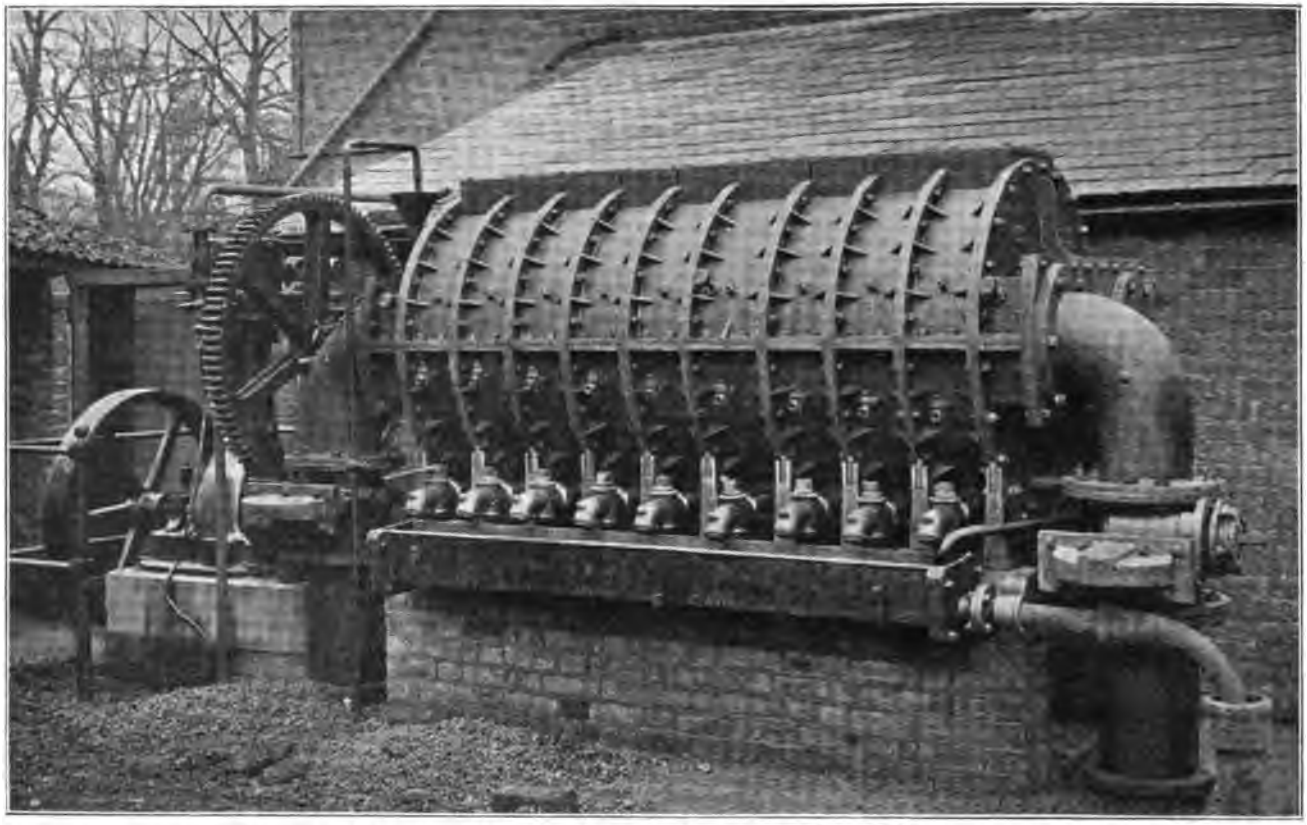
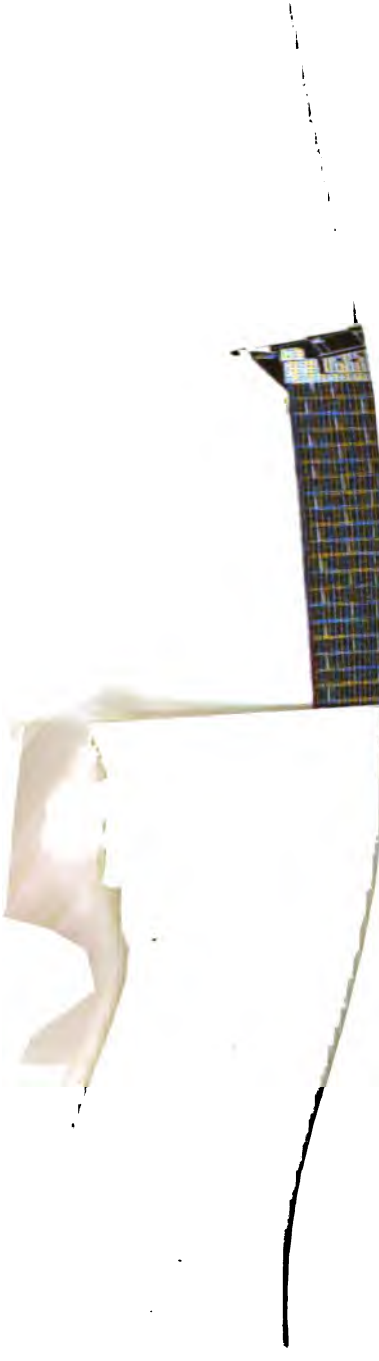


Figure 10. "Standard" Washer Scrubber. (Kirkham, Hulitt & Chandler, Ltd., London.)



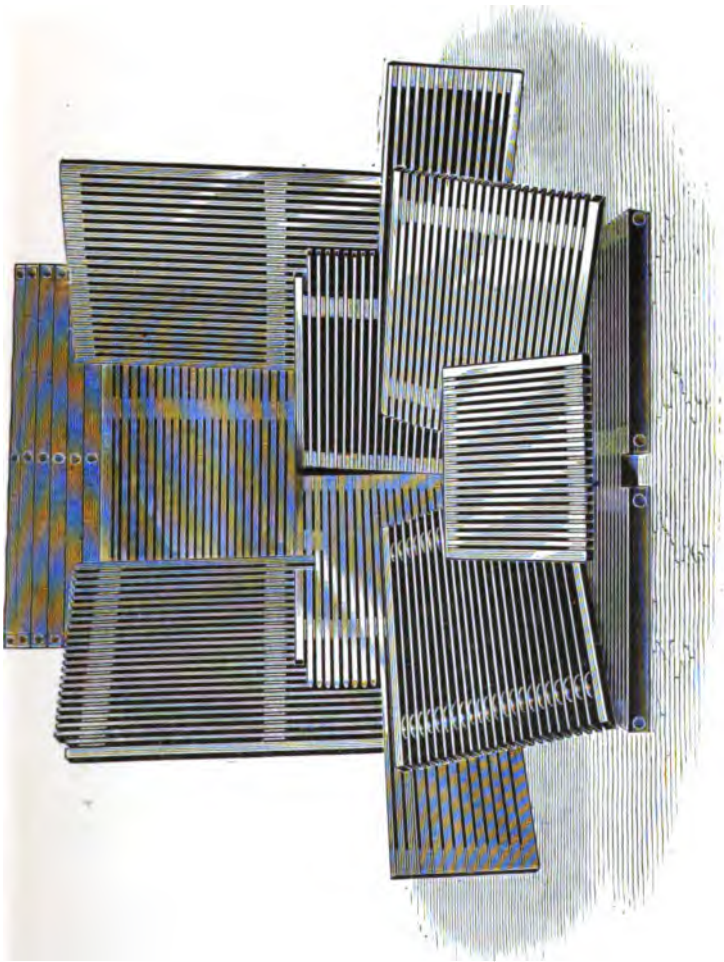


Figure 12. Wood Sieves for Purifiers. (R. & J. Dempster, Ltd., Manchester.)

brushes revolving in the water carry round with them a large quantity of liquid, thereby creating a large wetted surface, which results in the gas being scrubbed and washed in a very thorough manner. The speed of these machines is also intentionally very slow, only about three revolutions being made per minute.

Purifiers

The gas is now carried to the purifiers, large iron boxes with iron lids or covers, which fit into lutes or channels (filled with water) round the inside top edge of the box, thus forming a seal. Some are made with planed edges, the lids resting on the top edge of the box, which is faced with rubber to ensure a tight-fitting joint. These boxes are fitted with a series of wood grids or sieves, on which damp lime or damp hydrated oxide of iron (mixed with sawdust to secure porosity) is laid. Upwards or downwards through this material the gas slowly passes. When lime is used, carbonic acid, sulphuretted hydrogen, and other sulphur products are arrested. Oxide retains the sulphuretted hydrogen, but does not arrest carbonic acid (a lime box being necessary for this purpose), nor the bi-sulphide of carbon, which also, I understand, can only be released by the use of lime already impregnated with sulphuretted hydrogen, in other words, "fouled" lime.

Fig. 11 illustrates a purifier house with elevated purifiers, the floor being thus free for use as a revivifying place for the fouled oxide. The elevator shown is for carrying the supply of oxide to the boxes. In a purifier house an overhead crane or other lifting apparatus is used for raising the lids of the purifiers. The wood sieves with which purifiers are fitted are well represented in Fig. 12.

The processes of purification are now finished, and after the gas has been measured through the station meter it passes to the gas holder.

Gas Holder.

This usually consists of a tank, for holding water, below the ground level, well puddled and cemented and with walls or sides of brick or stone work. In some cases, to avoid constructional difficulties, a steel tank takes the place of masonry. In either case, into the tank is fitted the inverted cylindrical iron or steel vessel with which everyone is familiar. This is surrounded at regular

intervals with iron columns or standards (connected by framing). The holder is sometimes counterbalanced by having attached chains and weights which run over pulleys on the columns, but these are now in many cases dispensed with, and the holder is simply in contact with the columns of the guide framing through wheels attached to its top. Telescopic gas holders are numerous and have many advantages, not the least of which is that ground area is economised, and the weight of the lifts also assists the pressure. The different lifts are connected by the lower edge of the upper one being turned over outwards, and the top edge of the one below being turned over inwards thus forming a hook joint (known as the cup and dip), which is sealed by water in the usual way. Columnless gas holders are now also in use. Single holders have now been constructed of enormous storage capacity. The largest of which I have any record has a diameter of 300 feet, and has six lifts each 30 feet deep, its holding capacity being over 12,000,000 cubic feet. Fig. 13 illustrates a single lift gas holder, and gives a sectional view of the tank.

Gas Governor. The last piece of plant I have to refer to in detail is the gas governor, which regulates the pressure on the town mains. There are various kinds of governors now in use, and many of the devices for the purpose are so ingeniously arranged that a detailed description of one is desirable. Fig. 14 gives a vertical section (1) and end elevation (2) of Braddock's New Patent Governor, which has a gas chamber, divided by a partition *B* into an inlet chamber *A* and an outlet chamber A^1, the partition *B* having two openings *C* and *D* (one near to each end) fitted with faced seatings and provided with two parabolic valves *E* and *F*, the former closing downwards and the latter upwards, through which the gas passes (as shown by the arrows) from the inlet to the outlet. The valves are connected by valve rods *G G* and chains *H H* to the two opposite ends of a balance beam *I*, the centres of which are supported on pivots or knife edges *K* carried on a central pillar *L*. The rod *G* of the valve *E* (which closes downwards) passes out of the chamber *A* through a water seal *M* in the top of the outlet chamber, and the rod *G* of the valve *F* (which closes upwards) also passes out through a water seal at the top of the outlet chamber, but the water tank M^1 is made of larger diameter, and to the top of the valve rod *G* is attached a bell or holder *N*.

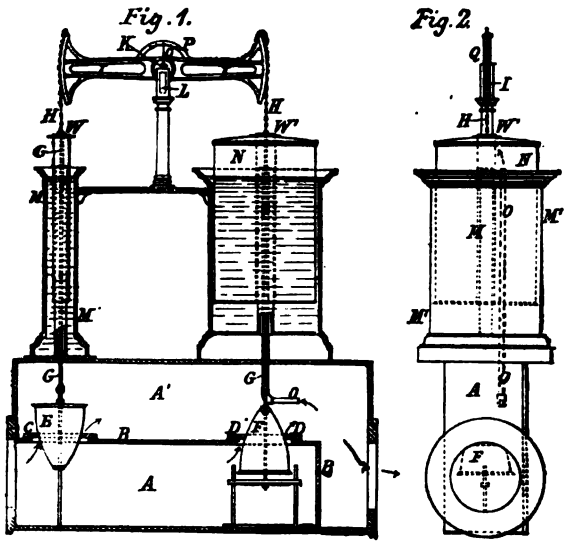


Figure 14. Gas Governor.
(J. & J. Braddock, Oldham.)

A pressure controlling tube *O*, open at both ends, is also fitted in the top of the outlet chamber A^1, so as to admit gas from the outlet into the bell *N* above the water level. The weights to give the outlet pressure are placed at W^1 or at *W*. If from diminution in the consumption of gas or from other causes the pressure in the outlet chamber A^1 increases, the bell or receiver *N* will be raised, and thus close both the valves *E* and *F* more or less, as may be required, so as to diminish or shut off the supply. If, however, the pressure in the outlet chamber A^1 should decrease, the bell *N* descends and opens both valves *E* and *F* wider, so as to increase the supply; and as the outlet chamber A^1 is in direct communication with the main, the pressure of gas in the latter will always be kept constant and steady.

It ought to be mentioned, before passing from the question of plant, that a set of gas pressure gauges are provided, which may be fixed in the engineer's office or exhauster room, showing pressures at all important points in the works, such as condensers, scrubbers, purifiers, gas holders, etc., etc.

Carburetting of Coal Gas.

In recent years the practice of enriching coal gas has been steadily developing, and we may safely anticipate that the process will become still more common. The use of cannel is thereby rendered unnecessary, the candle power can be increased to any required standard, and the deposit of naphthalene in the mains (a standing source of trouble in a country where the changes of temperature are so sudden) is largely prevented. For the purpose of enrichment, benzole, alcohol spirit, carburine or other similar light oils are used in a vaporised state. Only a portion of the total make of as requires this special treatment, a branch pipe being brought to the carburetter, the gas, after absorbing this new constituent, being carried to the main on the delivery side of the holder, and the whole supply passing through is thereby enriched.

There are several apparatus for the purpose in use, but we have hardly yet reached the end of the chapter as regards gas enrichment, and although I had written separate descriptions of the different plants which have come under my notice, it seems to me politic and desirable to simply deal with the general features always present, and leave minute details for some future time.

For the purpose in view we require a supply of light oil, a

holder or reservoir for its reception, and a carburetter, being a box or chamber where vaporising of the oil and the enrichment of the gas by its incorporation takes place. The oil is usually forced from the barrel by water pressure, a pipe being inserted for the purpose, and when the water is turned on it forces the oil through a connecting pipe to the elevated holder. At a lower level than the holder or reservoir, and connected by a pipe, is the carburetter, and the oil is fed into this chamber as required and here vaporised by a steam pipe. Connected to the carburetter chamber is the branch main before referred to, and the gas brought up absorbs the vapour and returns to enrich the full delivery passing through the principal main.

The whole of such a plant is of metal construction, and of course gas and air tight, but there will be a pipe and valve for drawing off any condensed matter in the carburetter. The weakest point, to my mind, is that one or more glass gauges are always present, and indeed seem indispensable. The number of these gauges varies, but I have seen as many as five gauge and sight glasses, comprising one sight glass on the supply pipe to the holder, which denotes when the oil in the barrel is exhausted, water then rising: two gauges on the holder or reservoir, when such is divided into two chambers; a sight glass on the connecting pipe on the holder to carburetter (showin flow of oil), and a gauge on the carburetter. As glass is so liable to fracture, and the oil is of such a volatile, inflammable, and explosive nature, it appears highly desirable that a carburetting plant should be in a detached building used solely for the purpose, and not containing any other plant, and that if artificial light is necessary, incandescent electric light only should be utilised.

Carburetted Water-Gas.

The term water-gas may need some slight explanation. It has been applied from the fact that steam plays an important part in the product, being decomposed in the presence of a high temperature, utilised in combination with heated carbon (coke), which extracts from the steam the oxygen and sets the hydrogen free, the combination of oxygen and carbon forming carbon monoxide, the result being that we have a gas in which hydrogen and carbon monoxide are present in something like equal volume. This gas is an excellent heat producer in combustion, but practically non-luminous, and therefore requires a

supply of heavy hydro-carbons in order to make an effective illuminant, and it is this important office of enrichment which the oil added fulfils, producing what is known as carburetted water-gas.

The production of the gas has increased very rapidly in this country (over 10,000,000,000 cubic feet is the estimate of the production during 1900), and plant for its manufacture has become a common feature at gasworks. This is of a very compact nature, as Fig. 15 will show. The generator is a cylindrical steel shell lined with fire-bricks, between which and the shell is packing of non-conducting material. The carburetter and superheater are similarly constructed, and in addition are fitted with fire-bricks or blocks arranged "checker-work" fashion. From the operating floor, the generator (in which a fire is started) is charged with coke through a feeding door at the top, after which the door is tightly screwed down, and the coke is brought to an incandescent state by means of an air blast. The producer gas thus obtained passes in turn through the carburetter and superheater (reinforced after a certain temperature has been reached by secondary air admitted to both), heating these chambers and then escaping through a valve at top of latter to chimney stack. When the desired temperature has been obtained (in the generator it is about 2000 degs. Fah.) in all three chambers, the blasts are shut off from each consecutively, beginning with the superheater, and the outlet valve to chimney is closed.

The process of gas-making now commences. Steam is turned on, and, passing through the coke bed in generator, becomes water-gas. This travels through a short pipe into the carburetter and spreads over the heated checker-work, as also does oil, which is simultaneously delivered in a fine spray by a centrifugal distributor (fixed inside the top of the chamber), and vaporised by the heated checker-work. The enriched gas then continues its course through another short pipe at the bottom of the chamber into the superheater, through which it rises, and the combination is here converted into a permanent gas. The gas is then led off down a take-off pipe into the washer (where dust and most of the tar are separated), passes into scrubbers, and then on to condensers. It is afterwards purified in the ordinary way for the removal of sulphur impurities and carbonic acid. No ammonia is produced, and another feature which distinguishes water-gas from coal-gas is that it is washed hot—washing, as you will see, preceding condensing.

The oil used for carburetting may be any class of crude oil or distillate of the petroleum family. I have had it described to me in broad language as something midway between a burning and a lubricating oil. This oil is pumped from a storage tank through a small-bore pipe, passes through a meter, and before reaching the carburetter is warmed by the gas passing from the superheater. The quality of the gas depends on the quantity of oil supplied.

When the air blasts are on, the process is known as the "blow" (lasting, say, four or five minutes). When steam is admitted and gas-making commences, it is known as the "run" (lasting, say, six or seven minutes). These processes continue to alternate one with the other except when a break is necessary to supply the generator with fuel, which occurs at intervals of about an hour.

The lever that opens the air-blast valves locks the oil and steam valves; in fact, the interlocking arrangements are such that no mistake seems possible in this direction, and gauges clearly denote to the gas-maker the pressure of gas, air, steam, and oil, while sight glasses are fixed through which can be observed the stage of heat reached in the apparatus.

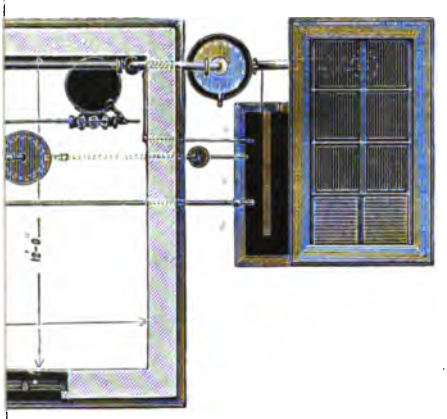
Coal-gas and water-gas may be joined in one main for passing to a common gas holder after the purifying stage, or they may be passed through purifiers together.

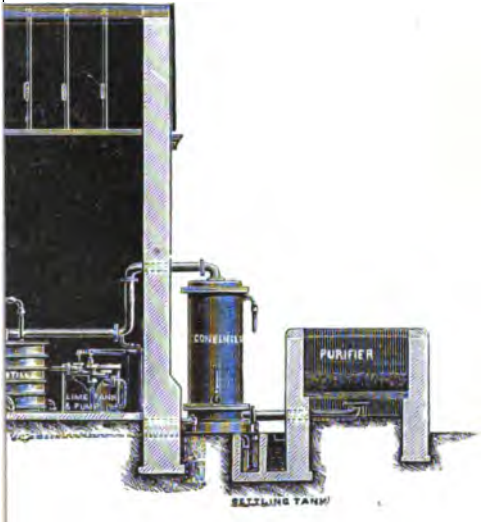
Sulphate of Ammonia.

Ammoniacal liquor is formed during the distillation of coal by the nitrogen of the coal combining with hydrogen. At one time this liquor was allowed to run to waste, but now it is utilised to a large extent for the production of sulphate of ammonia, a soluble salt valuable as a fertilising agent, and largely used by farmers for this purpose.

In the earlier days of sulphate production the liquor was sold for treatment elsewhere, but to-day sulphate plants are commonly found in large gas works, and it is estimated that the total production last year reached 210,000 tons, of which 138,000 tons came from the works under consideration.

In the process milk of lime and sulphuric acid are used. The liquor first enters a superheater, where its temperature is raised prior to travelling forward and entering (at top) the primary still (steam-heated), which is fitted with trays; the liquor passes over





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these, and enters a compartment at the bottom of the still fitted with an injector. Cream of lime and steam are also delivered here, and these are forced up through the injector together with the liquor, which is spread over the whole area of the still in a fine spray, and thus becomes thoroughly impregnated with the milk of lime before passing into the secondary still (also steam-heated), from which latter still the spent liquor flows away. The heat frees the volatile ammonia, whilst the fixed ammonia is released by the milk of lime, and the gases and vapours generated in both the primary and secondary stills pass forward through the same pipe to the saturator, containing sulphuric acid, which absorbs them, with the result that sulphate of ammonia is precipitated, and the foul gases remaining are carried from the saturator by piping, pass through the superheater, thus supplying the heat necessary for the preliminary heating of the liquor, and then travel on to condensers and purifiers. The sulphate of ammonia is fished out of the saturator and laid on the drainer, the whole process being now finished.

Fig. 16 represents a complete sulphate of ammonia plant, in which you will notice also the parts not specially referred to, such as lime tank and pump, liquor supply tank, acid tank, sulphate store, condensers, and purifiers.

The well-known corrosive and absorbent qualities of sulphuric acid, both alone and in combination with other substances, render it desirable that any stock be kept in some place where, in case of dispersion through fire or other catastrophe, it is not liable to affect property of any value.*

PART III.

A summary of the features (not already referred to) which appeal to one in gas works must be of a general and discursive nature, largely consequent on the fact that we are considering a class of risk varying in detail in many directions, and not confined

* Without attempting to deal with the matter in detail, it is well to mention that acids used at some works are largely charged with arsenic, and require purifying before use. This is accomplished in a closed vessel called a separator, in which the acid, together with the foul gases (carried forward from the saturator and superheater already named) are brought in contact, the latter causing a complete separation of the arsenic in the former, which is then arrested in a series of filter vats through which the acid is run. The foul gases may then be carried to a plant in the open yard for the purpose of recovering the sulphur they contain.

to any particular district as many other large industries are, but which is spread throughout the length and breadth of the kingdom. The feature which will, perhaps, have most interest is that, constructionally, gasworks have steadily improved. Retort-houses are now erected with the use of very little woodwork. Rafters, struts, and tension rods of iron to support either slate or wrought-iron roofs are, for new erections, I think the rule. In other words, wood beams, etc., etc., are things of the past so far as new works are concerned. The stage floor over subway is usually of steel joists or T bars supporting a floor of bricks or brick and concrete, or it may be iron, and, as already described, the retort benches are of necessity of incombustible materials, whilst the building as a whole is a roomy structure securing free ventilation, altogether very different to the low and limited erections of older days. On one or both sides, or forming an annexe to the retort-house, may be found the coal store, coal bunkers, or coal hoppers, into which (if the works are suitably situated) the coal is directly discharged from the railway waggons. In some works, where the provision has not been originally made, we find coal bunkers of wood construction carried down the side of the retort-house (an arrangement which might be a tered with advantage), or the coal store may be entirely detached from the retort-house. Much might be written on the question of spontaneous combustion of coal. We can only here record the result of recent investigations carried out in Germany. Of 29 cases under consideration the causes of fire were allocated as follows:—

Dampness	12
Dusty coal	3
Dusty and damp coal	2
High percentage of sulphur	1
Moisture and sulphur	3
Ventilation tubes	2
External heating	5
Two classes of coal placed together	1

The danger from this source necessarily varies according to the method of storage and kind of coal, and observant management is a great factor in reducing any hazard which may exist.

Before leaving the retort-house, it ought to be mentioned that movable coke fires are used on the top of retort benches for heating the long rods required to clear the ascension pipes when they become choked.

In connection with the handling of coal and coke, it is worth the attention of anyone having the opportunity, to inspect the remarkably ingenious machinery now in use for conveying, breaking, etc., and for charging and drawing retorts.

Washers and scrubbers are pieces of plant in the open which require no further reference.

The modern purifier house is another substantial and freely-ventilated structure. The oxide used requires revivifying at intervals, and this may be accomplished by driving air through the purifiers, but I have only found it being done on the old-standing system of spreading the fouled oxide on the floor of an adjacent revivifying chamber or in the open yard, or if the house is arranged on the principle illustrated in Fig. 11, it can be carried out on the floor underneath the elevated purifiers. The oxide (Irish bog ore is largely used), becoming saturated with sulphuretted hydrogen, changes its natural reddish brown to a much darker colour, consequent on the formation of iron sulphides, but when spread out, exposed to the air, and turned over from time to time, oxidisation of the sulphides occurs, the material becomes warm, and gradually assumes something like its original colour. These processes, of use (in the purifiers) and revivification, may be repeated over and over again, sulphur continuing to accumulate in the oxide until it contains 50 per cent. to 60 per cent. of free sulphur, when it is sold, usually to sulphuric acid manufacturers.* To discover the quantity of sulphur present, oxide in very small quantities is tested with bi-sulphide of carbon. This is purely a laboratory process, to which no special importance need be attached. The desirability of a non-combustible floor and surroundings for a revivifying house does not need enlarging on, as fouled oxide is liable to, and sometimes does, fire in course of revivification.

I am told the sulphur present in the form of bi-sulphide of carbon can only be effectively removed from the gas by means of lime already fouled with sulphuretted hydrogen.

At some works for purifying purposes lime only is used, at others oxide only, and at others both lime and oxide. Fouled lime, on being exposed to the air, rapidly rises in temperature as

* Sulphuric acid (in which sulphur plays an important part) is now, I understand, being made at some few large gas works, but until this becomes more general it can hardly be considered a normal feature, and has, therefore, not been described in this paper.

the sulphuretted hydrogen and bi-sulphide of carbon are expelled as a result of the oxidisation which occurs, and a mass of this matter easily fires. There are processes for revivifying lime by means of fire, but they do not seem to be commonly used, and it is usually disposed of to farmers for manuring purposes.

It is self-evident that the two developments (neither can be called new, but both are growing) on older methods—*i.e.*, gas enrichment (carburetting), and carburetted water-gas making, introduce in their train attendant special features. In the former case, any stock of benzole or similar oil should be kept in the most isolated position possible, and we must let events gradually prove what other precautions are necessary. The question of lighting—a very important one here—has already been referred to.

In the latter case, more or less large stocks of oil are kept, stored in closed iron tanks in the open, and these should be at a safe distance from any erection which might affect them or which, on the other hand, they might affect, in case of accidents.

Other parts of the works, such as the governor-house, mechanics', joiners', and plumbers' shops, need no special attention here. The plumbers' shop, in districts where gas stoves, etc., are freely hired out, may be found of a somewhat extensive nature.

I shall certainly hope to find, as already mentioned, every possible endeavour made to isolate the gas enrichment house, and an important step forward would be to have incandescent electric light, or failing this (and falling far behind), the most effective system possible of enclosed gas lights, used in certain parts of a gasworks. I would specify in particular the exhauster-house, governor-house, and carburetting-house. Experience proves that leakages which would have remained occurrences of no particular moment have been turned into serious catastrophes owing to the presence of naked lights. The question of effective ventilation is also one of very great importance, as there is a possibility of explosion when mixtures of from 7 per cent. up to 29 per cent. of gas are present in the air.

Fires or explosions have occurred attributed to the following causes during recent years:—

Accumulation of gas in tar well.
Leakage from purifiers coming in contact with gas jet.
Accumulation of tar in retort setting.

Leakage in exhausters through fracture (several).
Lack of liquor seal to valve connection.
Ignition of photometer lining.
Overflow of tar tank.
Tar finding its way into retort.
Accumulation of gas in retort which was being cleaned out.
Heat from retort bench igniting coal stacked against outer wall.
Cleaning out hydraulic main.
Accumulation of gas in setting of retorts temporarily disused.
Fracture of glass gauge on carburetter.
Spontaneous combustion of coal.

This list is anything but a complete one, and is simply intended to apply to the parts used for gas-making, fires in other portions, such as joiners' shops, etc., have been excluded, as also special cases of explosions traced to known causes outside those arising in the process of gas-making, and indeed of an abnormal nature. I may mention two such cases—one a very serious explosion caused by a man carelessly dragging away a pump which was attached to a rubber bag temporarily plugging a large gas main; another, where by an explosion at a chemical works a large piece of burning timber was blown a considerable distance and alighted on the top of a gas holder, fracturing it and firing the gas. I should have liked to go into this question of fires in much greater detail, but the short time at my disposal and geographical difficulties have made closer investigations impossible.

Here, gentlemen, for the present I must conclude the paper by saying that whilst the possibility of accident which gas involves, either by ignition or explosion, is known more or less to all of us, we must remember that gas production is in the hands of highly trained experts, and that mistakes or catastrophes are therefore not likely to occur from ignorance or inattention on the part of gas engineers under the conditions operating to-day. In pursuing my investigations this fact has been borne in on me more and more, and I have felt it an honour to have been brought in contact with gentlemen whose wide knowledge was only exceeded by their unlimited kindness and attention. For the supply of blocks, photographs, illustrations, drawings, catalogues, etc., I have to heartily thank the following firms—you will judge for yourselves how barren the paper would have been without

their use; in this direction, again, I have been met with the greatest courtesy:—

R. & J. Dempster, Ltd., Manchester; Humphreys & Glasgow, London; Kirkham, Hulitt, & Chandler, Ltd., London; W. C. Holmes & Co., Huddersfield; J. & J. Braddock, Oldham; The Leeds Fireclay Company, Ltd., Leeds; R. Dempster & Sons, Ltd., Elland; Whessoe Foundry Company, Ltd., Darlington.

JOHN HAWORTH CHAPMAN,
Norwich Union Fire Office.

Newcastle Insurance Institute,
March 15, 1901.

MISCELLANEOUS MATTER.

Part IV.

The following companies and local authorities use, in addition to coal, "oil, petroleum spirit, carburine, or other material" for the production of gas. This means that either carburetting of coal gas, or the manufacture of water gas, or, it may be, both processes, are carried on, or in some isolated cases the manufacture of oil gas :—

Alva
Ardrossan
Bath
Bexhill
Belford
Birkenhead
Birmingham
Blackburn
Bournemouth
Broughty Ferry
Brecon
Brentford
Bridlington
Brighton
Bristol
Broadstairs
Bury
Canterbury
Chigwell
Colchester
Chorley
Commercial
Coventry
Croydon
Crystal Palace
Darlington
Derby
Dorking
Dover
Dublin
Durham
Dumfries
Eastbourne
Eccleshill
Ely
Enfield
Epsom
Exeter
Edinburgh
Falmouth
Folkestone
Gaslight & Coke Co.
Godalming
Gravesend
Guildford
Glasgow
Greenock
Halesowen
Harrow
Hastings
Hornsey
Horsham
Hoylake
Hugton
Hereford
Huddersfield
Isle of Thanet
Ilkeston
Kingston-on-Thames
Leabridge
Leicester
Liverpool
Maidenhead
Maidstone
Musselburgh
Manchester
Middlesbrough
Newport (I. of W.)
Northfleet
North Middlesex
Norwich
Plymouth
Preston
Paisley
Peebles
Portsoy
Quarndon
Rochdale
Rotherham
Southport
St. Helens
Stockport
Stockton-on-Tees
Scarborough
Snodland
Southend
South Metropolitan
Staines
Swansea
Swindon
Taunton
Tottenham
Tunbridge Wells
Tynemouth
Tipton
Waltham Abbey
Wandsworth
Walford
West Ham
Winchester
Widnes
West Bromwich
Yarmouth
York

Carburetted water gas is supplied by the following companies or local authorities :—

Belfast	Epsom	Norwich
Birkenhead	Edinburgh	Plymouth
Birmingham	Falmouth	Preston
Blackburn	Folkstone	Paisley
Bath	Gaslight & Coke Co.	Scarborough
Bexhill	Guildford	Southport
Brentford	Harrow	Stockport
Brighton	Hastings	Stockton-on-Tees
Bridlington	Horsham	Southend
Colchester	Hoylake	Swansea
Commercial	Liverpool	Swindon
Coventry	Leabridge	Taunton
Croydon	Manchester	Tottenham
Crystal Palace	Maidenhead	Wandsworth
Dorking	Middlesbrough	Winchester
Durham	North Middlesex	York

The proportion mixed with coal gas varies considerably, the maximum quantity being apparently 50 per cent.

Coals for gas production are chiefly obtained from the Newcastle, Durham, Yorkshire, Derbyshire, Lancashire, and North Staffordshire coalfields.

Coal, composition of,—Carbon, hydrogen, oxygen, nitrogen, sulphur.

Coal, production from,—One ton of Newcastle gas coal will produce 10/11,000 cubic feet of gas, about 18 gallons of tar and liquor, and 1200 lbs. or upwards of coke.

The relative compositions of coal gas and carburetted water gas have been given by Professor Vivian B. Lewes as follows :—

	Coal Gas.	Carburetted Water Gas.
Hydrogen (H)	47·69	39·44
Marsh Gas (CH_4)	35·75	16·99
Hydro-carbons ($C_n H_{2n}$)	4·88	8·23
Carbon Monoxide (CO)	5·99	29·03
Carbon Dioxide (CO_2)	—	—
Nitrogen (N)	4·76	6·20
Oxygen (O)	0·95	0·21
Lighting power in candles	22·3	22·7
Density (air=1000)	549	647

Trade Journals—"The Journal of Gas Lighting" (6d. weekly).
"The Gas World" .. (3d. weekly).

J H. C.

HEATING AND VENTILATION.

AMONGST the various features of fire risks which Insurance men have to consider, those of the dangers arising from the various forms of Heating and Ventilation are certainly not the least important and interesting. There are many points which are strictly incidental to particular classes of risks, but here we have features which in varying degrees are common to all, or at least to most of the risks, with which we come in contact. In nature the operations of Heating and Ventilation are constantly at work, the motive power being the heat of the sun, which acting by radiation on the atmosphere causes a never-ending series of currents, which purify the air and give the necessary amount of heat, without which life on the earth would be impossible.

In treating a subject such as the one we have at present under consideration, it is perhaps advisable for our particular purpose to take Heating and Ventilation separately, and I will therefore endeavour as far as possible to do so, although the two are intimately connected and dependent the one upon the other.

Heating may be carried on in three ways, by *conduction*, in which the heat travels from particle to particle, raising the temperature as it creeps along; by *radiation*, by which the rays of heat are diffused in all directions; and by *convection*, as in liquid and air, where the particles nearest the source of heat become warm, and rise and impart their heat to surrounding particles, while the colder ones descend and take their place.

Heating in some form or other probably dates back as far as the days of pre-historic men, when they would no doubt crowd around their rude fire of wood, but the difference between this primitive means of obtaining warmth and those in use at the present day is as great as can well be imagined.

One of the earliest forms of heating of which we have any knowledge is that of the charcoal brazier, which in the days of the Grecian and Roman civilisations was a favourite means of warming

rooms, while the Romans had a somewhat primitive way of heating large rooms by hot air, the apparatus consisting of a fireplace built outside the room, the air and smoke being conveyed through the building by means of flues perforated at intervals. This was known as the "Hypocaust," and traces of such arrangements have been discovered in our own country at Lincoln and other places. In China it is in use at the present day.

As a general rule, however, for many centuries warming was carried on in a similar way to that even now adopted in many Irish cottages, *i.e.*, a fire was lighted on the floor, and the smoke was allowed to make its escape through a hole in the roof, or as best it could, and it was only in process of time that a chimney was gradually evolved. In the days of our Saxon forefathers the houses were generally only one storey in height, and the want of the chimney was not greatly felt, but when buildings of two storeys and upwards began to be erected some other means of carrying off the smoke became necessary, and a chimney, generally constructed in the thickness of the wall, slowly came into use. Although coal and its uses were known ages ago, it was not until the beginning of the 17th century that its use became at all general. Previous to that time wood was the principal article of fuel. Indeed great objection was at first taken to the employment of coal at all, and many laws were passed against its use. It is even recorded that in the reign of Edward I. a man was tried, convicted, and executed for burning coal in London.

Perhaps the nearest approach to the charcoal brazier referred to is the open grate with which the modern jerry builder, eager to get his houses ready for the next quarter day, dries the rooms. This at first sight may appear somewhat hazardous, but in practice, so far as I know, is not responsible for many accidents. At the same time as a general means of heating it is not to be recommended, and should be looked upon with suspicion wherever it is found. I have come across several of these braziers during the past few years, but these were generally in the moulding shops of iron works, where the absence of woodwork made them comparatively speaking harmless.

Common Fires. The ordinary fireplaces, with which we are all so familiar, and with which in offices, houses, warehouses, and other places too numerous to mention, we are constantly coming in contact, are seemingly inno-

cent enough, and in most cases are so, but occasionally we hear of fires which have been traced to these. As a rule the cause appears to be some defect in the construction of the chimney flue or the hearthstone. It is of the first importance that the hearthstones should be of sufficient thickness, and that no woodwork be used to support them. Two cases came under my notice quite recently where a company had to pay losses on fires caused by wood beams having been used as supports to the hearthstones, the wood in course of time charring and igniting and thus setting fire to the premises. No doubt many of you will be able to recall other incidents of a like nature. In another case a badly constructed register grate allowed an accumulation of soot, which one fine morning became sufficiently hot to fire a beam which was where it had no right to be, with the result that a loss of several hundred pounds had to be paid.

Chimney flues, especially in old mansions, have been responsible for many serious losses, and this is not at all surprising when we remember the number of wood beams and rafters which we come across built into the chimney breasts. This woodwork in process of time, owing to the wearing away of the bricks and mortar and the consequent lodgment of soot, becomes charred and ultimately bursts into flames, often with serious results. Some few months ago I was inspecting an old building which was undergoing alterations, and was shown an old oak beam which had just been taken down. This had originally been built into the chimney and was charred at one end for several inches. In this case it was removed in time, but how many cases are there where the first intimation of anything wrong is a claim for compensation after a fire has occurred?

Another point which is worthy of attention in this connection is the frequency with which chimneys originally intended for one purpose are converted to another. For example, a chimney built in the first instance to carry off the smoke from an ordinary house fire may in course of time be used in connection with a bakehouse or possibly as a flue to a boiler, and while perfectly safe in the first case may be altogether wanting in the others.

When going through a building you occasionally see disused fireplaces which are made up with wood or paper. In these cases it is best to insist on them being built up with brickwork or metal, especially if any fireplaces connected with the same flue are used, as a fall of hot soot may at any time cause a disaster.

Fireplaces in Workshops.

In small cabinetmaking workshops we are constantly coming across fireplaces which serve the twofold purposes of heating, and of warming the glue, and in addition it frequently happens that shavings and other refuse are burned in them. A similar arrangement is to be met with in tailors' and such like workshops, where, besides serving to warm the rooms, the fires are used for heating irons. These fireplaces are generally brick built, with an iron plate on top, and as a rule extend some few feet into the room, the brickwork resting on a flagstone or on an iron plate resting on the wood floor. When, as is sometimes the case, the flagstone is cracked or the metal plate is too thin, a considerable amount of danger is created. In addition, the guard or fender, as often as not, is not in its place, and the fireplaces are not very strongly built, and very soon get out of repair.

Open fireplaces, however cheerful and pleasant they may appear to the eye, are certainly very wasteful and expensive, much of the heat being carried by the draught up the chimney, and in premises where economy must be observed various devices have been adopted for obtaining the requisite amount of warmth with the least possible expenditure, the attendant risk from fire being often quite ignored.

Gas Stoves.

Offices and small rooms are very frequently heated by gas stoves, of which there is an endless variety. They depend for their warmth on radiation from luminous flames, or from asbestos heated by Bunsen burners, or upon the heating of a metal casing by Bunsen burners. A good deal of heat is generated, and I have often found the metal pipes used for carrying off the waste products of combustion so hot as to burn the hand if touched, and woodwork near has shown evident signs of the heat. Rubber piping is sometimes used for the gas, but this, on account of its liability to injury and the consequent escape of gas, should be discouraged.

Oil Stoves.

The use of oil stoves is on the increase, but the unpleasant smell given off prevents them from being so generally used as they otherwise might be. Provided a good class of oil is burned, their presence in a risk does not appear to create any particular danger, but where a low-flash and poor oil is used considerable hazard is to be

apprehended. Judging by an article which appeared in the New York Insurance Press some two years ago, the experience in America with this form of heating seems to have been very unfavourable. The writer says:—"The fire record of these devices "is largely out of proportion to the number in use for heating "purposes, and the only practical method of eliminating the "hazard of their presence appears to be that of entire prohibition, "as even under the most favourable conditions of use in experi-"enced hands they have proven very dangerous."

Pipe Stoves. Pipe stoves are a fruitful source of accidents. In reading through our Tariff Warranties we are constantly coming across such phrases as "No pipe stove allowed," or "No stove with more than 3 feet of smoke pipe allowed," showing that in the opinion of the Fire Offices Committee such features in a building lend an additional hazard to the risk. That this is a correct view to take, the numerous fires which can be annually traced to this cause easily prove. The surprise is not that so many fires occur, but that there are not more. The average man when he puts up a stove seems to think first and last only how he can place it so as to obtain the most heat, and it never seems to dawn upon him that there may be a certain amount of danger from a stove fixed on a wood floor, or touching a wood partition, or from the smoke pipe running near to or against woodwork. So little indeed do some people anticipate anything going wrong that sometimes if a crack or hole develops in the pipe, and the smoke annoys them, they will stop up the aperture with rags or paper, and are quite surprised when you express your opinion on the subject. Stoves may roughly be divided into two kinds—the closed or slow-combustion stove and the open stove. In the first kind the fire is fed from the top, the draught being provided from below. These stoves as a rule are of strong construction, and do not directly touch the floor. The open stove is of endless variety —some raised on legs above the floor, while others are placed directly upon it. The danger from the two classes is pretty much the same, except that in the slow-combustion stove there is not the same risk of the ashes falling out on to the floor.

Where stoves are placed on iron plates, as is often the case, there is always the danger of the wood flooring beneath becoming

carbonised by undue heating of the stove. All stoves should be fixed upon a stout flagstone and provided with a guard, say 12 inches high, to prevent the cinders and ashes from falling on to the floor. The state of the pipes and the way in which they are fixed are very important points, and long pipes should as far as possible be discouraged. As a rule, the longer a pipe is the worse condition it will be in, and not infrequently you will find the joints in a bad state of repair, and as it were asking some fiery bit of soot to find its way through and settle on some convenient bit of inflammable material. Where necessary the pipes should be supported by slings from the ceiling, and where it is impossible to prevent them from being near woodwork this should be protected by asbestos. Metal plates, when attached directly to the woodwork, are of very doubtful value, and there should always be an air space left between the wood and the iron or tin. Tin is a worse conductor of heat than iron, and should be used in preference.

So far I have been dealing with stoves simply as a means of warmth, but they are also not infrequently used for the purpose of drying, and where this is so, in addition to the points I have mentioned, it is necessary to examine very closely the arrangements made for drying the goods, and to see that there is no danger of any article falling either on the stove or the pipe. Where possible the stove should be fired from outside the room, and where drying is done in the same compartment as the stove, wire guards should be fixed so as to do away with any possibility of goods coming near the stove or pipe. This is absolutely necessary, as often where such a method of drying is adopted, as in hat works and laundries, the stoves will be heated till they are almost incandescent, and have been responsible for many fires. If no drying is done in the same compartment, the nature of the floor above and the distance from the stove should be carefully noted. Where possible the floor should be constructed of non-combustible materials.

In small joiners' shops where stoves are used for heating, timber is often dried on wood racks, placed in some cases only a few inches above the stove or pipe. As there is always a possibility of the stove becoming overheated, the use of such racks is not a desirable feature, and should not be encouraged.

Steam Pipes. In works, especially in those of large dimensions, heating by means of steam pipes is very generally adopted, and perhaps this method is about as safe as any at present in use. It is allowed by the Fire Offices without any additional rate. Where steam is used for manufacturing purposes a system of pipes is connected with the engine, and the exhaust steam is utilised, but in cases where no power is used a small vertical or horizontal boiler is put down. This method of heating has been in use about 100 years, a Mr. Lee of Manchester having in 1799 erected a heating apparatus of cast-iron pipes. Previous to this, in 1784-5, James Watt had fitted up an apparatus for warming his study, and in 1791 a Mr. Hoyle of Halifax took out a patent for heating by steam pipes, but in this case the pipes, which were of copper, were too small, and the attempt was a comparative failure.

Some doubt appears to exist as to whether ordinary steam pipes can be heated to such an extent as to cause fires. Mr. Harris, in his book on Insurance Chemistry, gives numerous examples from American sources of cases where steam pipes are supposed to have originated fires, and it may be interesting to give an extract from the remarks of a Mr. J. C. Moore, quoted by him. This gentleman, writing on steam pipes and their dangers, says:—

"This is a subject to which we desire particularly to call your "attention. It has at last become a serious question whether "stoves—because of their admitted danger and the consequent "care in their management—are not safer than steam pipes where "the manufacturer entertains doubts as to the ignition of wood "by them when in contact with it. Unfortunately the causes of "most fires are never discovered. All traces are lost in the ruin "which follows the conflagration, but sufficient statistics of well-"authenticated cases of fires from steam pipes have been secured "to convince the most sceptical on this point." He then gives a list of some 13 cases, and says:—"It must be borne in mind, "however, that it is difficult to catch such a dangerous incendiary "red-handed in the act. Our list might be larger."

Mr. Tozer, late Superintendent of the Manchester Fire Brigade, when reading a paper before the Manchester Association exhibited a specimen of wood which was badly charred by the action of steam pipes, and anyone who has been through a drying room cannot failed to have noticed the extremely dry state to which the woodwork has been reduced, but I do not think it has yet

been clearly proved that steam pipes in themselves are sufficient to cause a fire. In cases where this is supposed to have occurred, I believe it will be found on enquiry that other factors have been at work contributing their share to the result. It is quite a common thing to come across steam pipes fixed immediately on woodwork, and exposed to the action of dirt, grease, and moisture. Take as an example a tannery. As often as not in the drying room you find the steam pipes placed on the wood floors, which, from the nature of the risk, are bound to be more or less saturated with grease; dirt and dust accumulate, and everything is in readiness for an outbreak, particularly if, as I have more than once found, sawdust is used to take up the excess grease and moisture. Here are all the elements necessary for a case of what for want of a better name we term spontaneous combustion, and the Offices have the pleasure of paying another loss the cause of which is written down as unknown.

It must be borne in mind that the heat from steam pipes does not as a rule exceed 320° Fahr. (and is often very much less), which in itself is insufficient to fire woodwork, the ignition point of which is said by Professor Roscoe to be about 725° Fahr., and by other authorities to be from 645° to 700° Fahr. At the same time the heat is quite enough to make the woodwork very dry and more or less like tinder, and this, together with the untidy state of the rooms, dirt, grease, and moisture, are quite enough to create a serious danger, though unfortunately you cannot always make the Insured see it in the same light.

Another point which might be mentioned is that of friction caused by steam pipes. This, where steam at high pressure is used, is very considerable, and indeed in every case where steam is used is always present to a more or less degree. Several fires have occurred that have been attributed to this cause.

Taking all these points into consideration, it appears to me that wherever steam or hot-water pipes are used for heating purposes it is highly important that they should not be allowed to touch the flooring, but should be raised several inches above the floors on metal or preferably stone or brick supports, that no woodwork or other inflammable material be allowed near them, and that the rooms be kept as clean and free from dirt as possible.

Superheated Steam.

Heating by means of superheated steam is not very often adopted, at any rate in this part of the country, and personally I have never come across a risk heated by this method, though I understand it is occasionally met with in patent fuel works and other risks where a great heat is required.

Superheated steam is described in the Tariff Rules as "steam entering the pipes at a higher temperature than 350° Fahr." It is steam which receives additional heat apart from water, and approximates to the condition of perfect gas. Where used, the live steam from the boiler (at ordinary pressure) passes into coils under which is a furnace, the latter being enclosed in firebricks. The steam is heated to 350° Fahr. and upwards, and then passes into the building which is to be warmed. The heat both in the furnace and in the pipes is intense, and the dangers from such a system are so obvious that it is not strange that the Fire Offices generally have placed an embargo on its use.

Heating by Hot Water.

Where from various causes it is inconvenient to heat premises by means of steam, a system of hot-water pipes is often adopted.

Heating by hot water is no new idea. It was certainly known to the Romans, in whose height of power and splendour the use of the bath, both public and private, formed a most important feature of social life, and some method of heating by means of the circulation of warm water was generally in use.

So far however as the modern system of heating by hot water is concerned, we can hardly date further back than 1818, when we find that a Marquis de Chabonnes heated a conservatory in this way, though it may be mentioned that previous to this, as far back as 1716, Sir Martin Triewald described an arrangement for heating a greenhouse by hot water, while in 1777 a M. Bonnemain invented an apparatus for hatching chickens, the heat in this case being obtained from water made to circulate by means of the heat from a boiler. The principle on which all systems of heating by the circulation of hot water depend is that of convection. On the water becoming heated by means of the boiler it rises, and the cold water rushing in to take its place a current is created through the pipes, which,

as the hot water passes through, become warmer, and the heat passes into the rooms by radiation.

The various systems in use at the present time may be roughly divided into two, that of the small-bore or high-pressure, and that of the large-bore or low-pressure system. From our particular standpoint the risk of fire is very much greater in the one case than the other, and whereas the low-pressure apparatus is allowed without extra charge, the high-pressure arrangement is either prohibited entirely or a special extra is charged.

High-Pressure Hot Water.

The high-pressure system was first invented by Perkins, and was patented by him in July, 1831.

Modifications have been made from time to time, but its main features remain as at first. No boiler is used. The apparatus in its simplest form consists of a metal tube, $\frac{7}{8}$-inch bore, with an outside diameter of $1\frac{5}{16}$ inches, the pipes generally being made of wrought iron; this in part of the circuit is arranged in coils, which are placed in the fire or furnace, and in some cases the portions of the pipes in contact with the flames are constructed of mild steel. All the pipes are screwed into one another. Originally pipes of $\frac{1}{2}$-inch bore and 1 inch outside diameter were used, but on account of the great amount of friction thus caused, the modern size of the pipe was adopted, and found to answer much better. The water in the coils in the furnace on becoming heated, becomes specifically lighter than the cold water and rises to the top of the apparatus, so displacing the cold water, which passes in its turn into the coils to be heated, and so creates a constant circulation. Another factor at work is the height to which the hot water ascends, and from which when cool it descends, as the higher the water is carried above the furnace, and the further its descent, the quicker and more powerful will be the circulation. As will be readily understood, when the water is thus heated it expands, and to allow for this an expansion chamber from 3 to 5 inches in diameter, and proportionate to the size of the apparatus, is fixed at the highest point of the system, and forms a receptacle into which the surplus water of expansion rises. In a line with the bottom of this pipe is a pipe for filling, into which water is poured occasionally, a little being wasted by evaporation, but as the apparatus is practi-

cally closed to the atmosphere, very little evaporation takes place. All air is expelled from the installation at the time of erection.

In the following diagram, Fig. 1, *a*, *b*, *c*, *d* is the metal tube $1\frac{5}{16}$ inch in diameter, of which *a* is the flow pipe, *b* the return pipe, *c* the piping in the room to be heated, *d* the coil or furnace, *e* is the expansion tube, *f* the air pipe, and *g* the filling pipe.

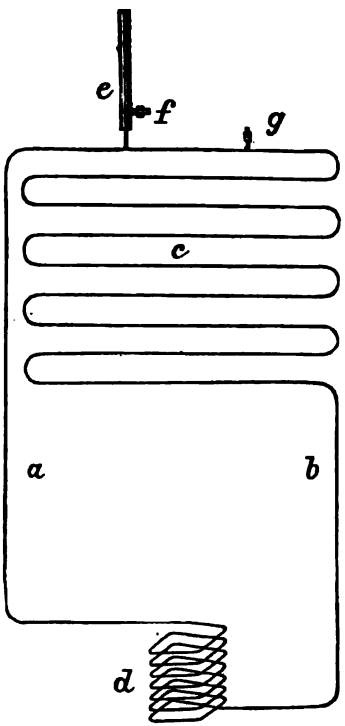


Figure 1.

Owing to the very great pressure to which the pipes are subjected, it is necessary that very strong materials should be used, and as a rule, when an apparatus has been fixed, it is tested by hydraulic pressure to 3000 lbs. on the square inch. As high-pressure pipes may be subjected to a pressure of 500 lbs. and upwards to the square inch, this is necessary. The usual heat of the water will be from 300° to 350° Fahr.

Various arrangements may be used for heating the water, depending mainly on the size and extent of the premises to be heated. Fig. 2 shows one of the simpler forms, such as is often used in houses and offices. This consists of a coil of pipes arranged in an ordinary fireplace, the pipes taking the place of the ordinary fire-bars. Where a larger apparatus is necessary, the coils are arranged in an iron casing or furnace or in a brick-built furnace. Fig. 3 will give some idea of the arrangement usually adopted in such cases. The fire is placed upon the fire-bars *a a*, in the space enclosed by the coils *c c*. The flames, being prevented by the brick bridge *b* from passing direct to the flue, pass through the front of the coil, and between the outside of the coil and the outer case in the spaces *f f*, and then into the flue. In this way the whole coil is exposed to the direct action of the flames and hot gases. In the diagram *e* is the trap for removing the dust, and *s s* are two small soot holes.

It will be easily seen that a great heat can in this way be obtained, and it is necessary that great care should be exercised when fixing the pipes, and that no woodwork or other inflammable material be allowed in immediate proximity to them.

Low-Pressure Hot Water.

Heating by low-pressure hot water is largely in use, and where ordinary care is exercised, and provided that the stove or boiler is securely fixed, does not present any very considerable degree of hazard from a Fire Insurance point of view, and is allowed by the Tariff Companies without any additional charge, provided the boiler 'smoke pipe be not in excess of the usual 3 feet. In this system the water is heated to about boiling point by means of a stove or boiler, and then circulates through the building through cast-iron pipes, 2, 3, or 4 inches in diameter. The types of boilers used vary considerably according to the size of the premises, and also to some extent on the nature of the water used, some waters requiring a much larger waterway than others on account of the sediment deposited. Fig. 4 shows one of the simplest forms of apparatus used. This consists of a stove constructed of steel, and formed of two cylindrical plates, between which is a cavity containing the water, which is heated by a fire inside the inner plate. For larger premises a somewhat different system has to be adopted, one often met with being that of the sectional tubular

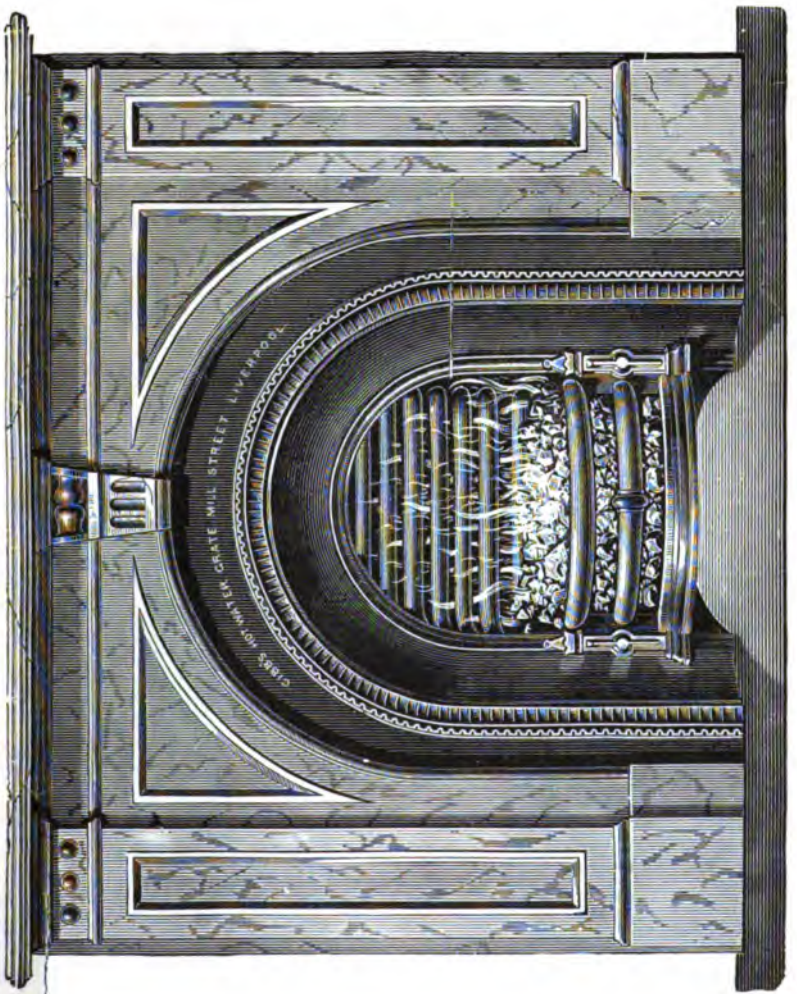
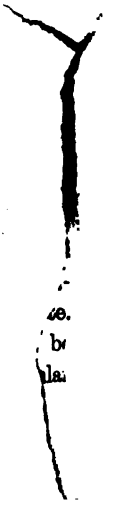


Figure 2.



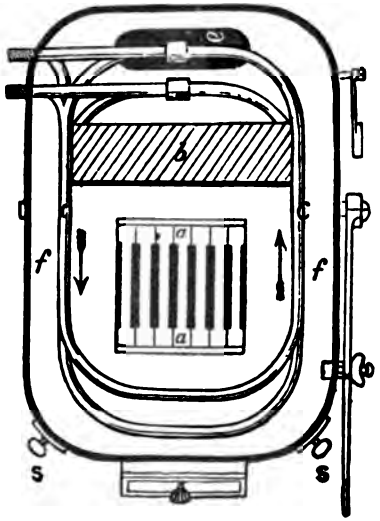


Figure 3.

Figure 4.

SECTION THROUGH BOILER. FRONT VIEW OF BOILER.

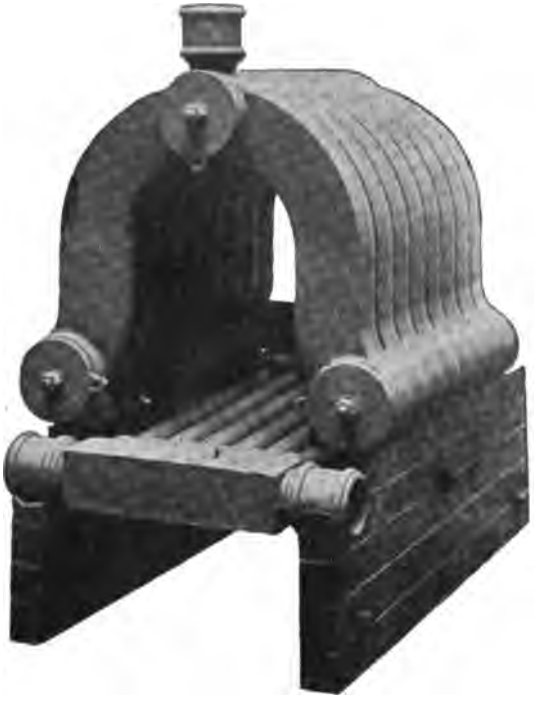


Figure 5.

SECTION. SECTION. ELEVATION.

Figure 6.

saddle boiler, which is generally set in brickwork, but occasionally the tops of the tubes are simply cased with metal. The accompanying diagram (Fig. 5) will give some idea of the construction. The boiler consists of a number of cast-iron hollow saddles of various sizes, according to circumstances, arranged so as to give the greatest amount of heating surface in the least possible room, the flames from the fire playing round and between the various sections Another type of boiler much in use is the Severn boiler, of which Figure 6 is a representation.

Hot Air. Heating by means of hot air was early tried, and I have already casually mentioned the Hypocaust used in the time of the Romans. Towards the end of the 18th century many experiments were made in this direction, in some cases the ordinary fires being used as the means of heating, and the air being brought into the rooms through channels running under and behind the fireplace. In a more recent system a large air chamber was constructed at the back of the grate, in which the air was heated and was then distributed by flues to the different rooms.

Another way was by means of what was known as the Belper or Cockle Stove, which was invented by a Mr. Strutt of Derby, and with which in 1792 he warmed his large cotton mills at Belper. This consisted of a stove of cylindrical form, surrounded at a certain distance by a mass of brickwork, the space between forming a chamber in which air supplied from passages below or from the outside was warmed, the warm air then passing through one or more openings into the rooms, the smoke finding its way out by a separate flue.

One method in use at the present time is to cause air from the outside to pass through brick or metal ducts into pipes placed over a brick-built furnace. The air becoming heated is carried into the various parts of the building through air shafts built in the wall, or through a central brick-built flue running through the different floors, the heat of the furnace being sufficient to cause the necessary current. Occasionally in the more modern plants the air is forced through by means of a fan. In an improved form of apparatus the place of the furnace is taken by a series of steam coils, the arrangement otherwise being the same. This last-mentioned system is known as "steam-heated air," and no extra charge for heating is made where it is used.

Langfield's System.

The Langfield system differs rom the other forms of heating by hot air inasmuch as an attempt is made to overcome the dryness generally to be met with in cases where hot air is used for warming purposes. The apparatus consists of an iron-built furnace enclosed in brickwork. At the sides between the iron frame and the outside brick covering is a series of wrought-iron tubes. These tubes are open at the bottom to a cold-air duct, which draws fresh air from the outside of the building. The air in the tubes is warmed by the action of the heat of the furnace, and rises into a chamber between the top plate of the furnace and the top brickwork, and then passes into the rooms by means of ducts or flues constructed of brick or metal, terminating at the floor levels in gratings fitted with open-and-shut valves. The moistening process is carried on by means of a small iron pipe passing through one of the tubes, and connected with a small water cistern fed from the ordinary water supply and fitted with a ball tap, the heat of the furnace being sufficient to convert the water into steam, which blows into the air chamber at the top of the furnace. The smoke is carried off by a separate brick or metal flue, and provided the whole of the apparatus is properly built and free from woodwork, there does not appear to be any very serious objection to its use. The arrangement will be easily seen by reference to the following diagram (Fig. 7). Here **A** is the cold-air duct drawing air from the outside, **B B** are the top and bottom plates of the furnace, **C C C C** are wrought-iron tubes open to **A** and passing into the space at the top of the furnace; **D** is a wrought-iron collar fixed on each tube; **E** is the wrought-iron case surrounding the firebox; **F** brickwork surrounding the case; **G** water tank; **H** small pipe for moistening; **K**, **K**^{1}, **K**^{2}, **K**^{3} firing place and ash place; and **L** the smoke flue. The exit for the vitiated atmosphere is either by the ordinary fireplace and chimney or by a cavity specially fixed. This system is in operation, among other places, at the Oldham Technical Schools and the Salford School Board Offices.

Heating by Electricity.

Perhaps in no branch of science has so much progress been made in recent years as in electricity. Heating by means of electricity is comparatively a new feature, at least in a practical form, but there is no doubt but that as time goes on, and

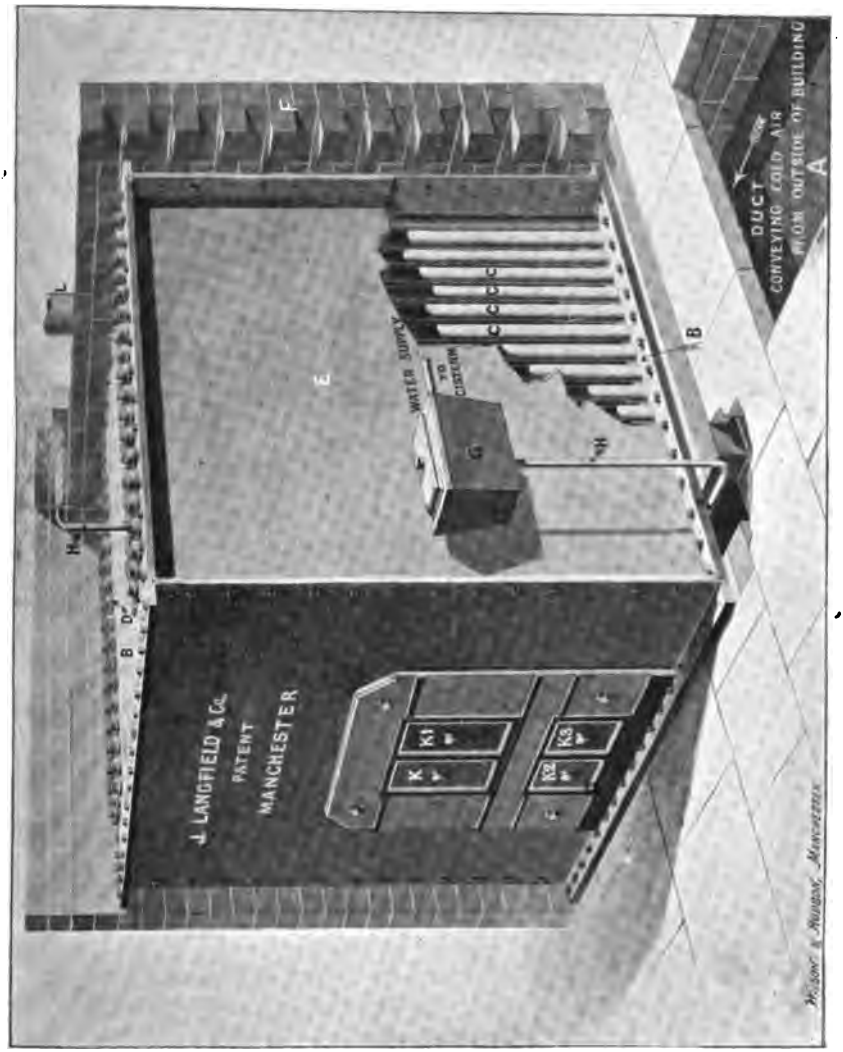

J. LANGFIELD & Co.
PATENT
MANCHESTER
DUCT
CONVEYING COLD AIR
FROM OUTSIDE OF BUILDING
WATER SUPPLY
WATER
CLOSETS
A
B
C
D
E
F
G
H
K
K1
K2
K3
L

Figure 7.

cheaper and easier means of utilising the heat are discovered, it will come into much more general use. At present the great objection is its relative high cost as compared with other methods of obtaining warmth, but it is pretty certain that in the not very distant future it will be a factor which will have to be taken into consideration. One great point in its favour is its great cleanliness. The heating is carried on by means of radiation. In the Crompton and similar systems a series of resistance coils is embedded in a special enamel to protect the wires, the whole being enclosed in metal cases studded with bosses. On the current being passed through the wires, these become heated, the heat being radiated by the case and bosses. Two or more switches are fixed so as to regulate the amount of current passing through the apparatus. Dowsing's patent is on another plan. In this system a number of incandescent lamps are arranged in a copper screen, which radiates the heat. In these lamps the vacuum is imperfect, and the oxygen left in the tubes gives the required heat.

The principal point to be observed appears to be that as electricity can readily be changed into fire, all radiators should be fixed at a safe distance from wooden and other combustible materials, and that the usual precautions taken with regard to electric lighting should be adopted.

A considerable number of electrical appliances for cooking, heating water, foot warmers, etc., etc., are now in use, but as regards more general application to the heating of buildings not very much progress has been made in this country, the cost standing in the way at present. The Vaudeville Theatre, London, is one of the few buildings heated throughout by electricity.

Drying Stoves. I would now like to turn for a few minutes to the question of drying stoves. In a large number of works it is absolutely necessary to have special facilities by means of which articles in process of manufacture can be dried readily.

These drying stoves require very careful attention whenever they are met with. It is impossible, in the limits of this paper to go very closely into the different systems adopted and their various hazards, much depending on the character of the goods

under treatment, but in all cases it is as well to insist upon the buildings in which the drying is carried on being cut off from the remainder of the premises, and that the floors where the actual drying is done should be at a safe distance from the source of heat. In a dye works I was inspecting the other day I came across three different kinds of stoves, the first consisting of a drying room with a wood floor fixed some few feet above a steam boiler, the second one had some trellised floors over pot stoves and metal flues, the stoves being fired from outside the building, and the third was a brick and iron built chamber, entered only by iron doors, and heated by means of air, which was warmed by being driven by a fan over steam coils. Drying by means of the pot stoves referred to is not infrequently met with in dyeing, bleaching, and finishing works, and sometimes the smoke flues are as large as 2½ feet in diameter. They are arranged round the room in the form of a coil. No goods should ever be dried in the same compartment as, nor should the floor above be allowed to be too close to, the stoves and/or pipes. I have several times come across the stoves quite red hot. In hat works it is a common thing for the hat bodies, proofed or unproofod, to be dried on racks fixed a few inches over a steam boiler, these racks occasionally being constructed of wood. Where spirit is used in the proofing this constitutes a considerable danger. Timber again is often dried on racks, fixed in some cases only a few feet above a steam boiler. In malt kilns the usual principle of drying is a brick arched firing place on the ground floor, with a floor over composed of perforated tile or brick, or metal or fine mesh wire. The drying rooms in laundries have been responsible for a good many fires. One very favourite arrangement is to hang the clothes from hooks or on strings round a stove, which, as it is also often used for heating irons, is sometimes almost red hot. The goods are supposed to be hung at a safe distance, but every now and then an accident occurs, the clothes fall on the stove, with the usual result. In some of the modern laundries, however, this objectionable form of drying has been superseded by a system of hot-air drying, where the air is driven over steam coils by means of a fan, this mode being more satisfactory in every way, and certainly much safer. In potteries and brickworks, the flues from the boilers to the chimney are sometimes utilised as a means of drying.

Ventilation.

We now come to the second part of our subject —*i.e.*, Ventilation. This is a most important matter, but is not so much taken into consideration as it might with advantage be. From a sanitary point of view it is highly essential, and much might be said on this side of the question, but I am afraid that some of us look upon it with a considerable amount of suspicion, imagining that ventilation necessarily means a draught, and is consequently an aid to spreading a fire in case of an outbreak. On the other hand, in many classes of risks it is an absolute necessity, not only on account of health, but also from the standpoint of a Fire Insurance official. Corn mills where dust capable of creating a serious explosion is liable to accumulate, logwood grinding mills, flannelette raising works, and premises such as oilcloth and baize works, where inflammable vapours are given off during the processes of manufacture, may be cited as examples of risks where a thorough system of ventilation is desirable on every ground. The recent disastrous explosion at Messrs. Wilson & Sons' hatworks at Denton, where several lives were lost, and damage amounting to £4000 or £5000 was done, shows very clearly how easily we may under-estimate the dangers arising from ordinary trade processes. In this particular case some proofed hats — *i.e.*, hats in process of manufacture, which had been steeped in a preparation of shellac, methylated spirit, and resin—were placed to dry in a drying stove heated by flues, which were fired from outside the building. No artificial light was used in the stove. From what cause it is not and probably never will be known, but suddenly a violent explosion took place, and the building and the adjoining proofing shop were blown to atoms. The stove at the time would be full of the vapour given off from the hats, and one theory of the disaster is that someone struck a match, while another is that the vapour managed to pass through some crevices in the brickwork to the kilns, but of any actual proof of either of these ideas there is none. The whole sad occurrence emphasises very strongly how necessary it is to have such places thoroughly ventilated.

One thing must be borne in mind, and that is that the Board of Trade insists on a system of ventilation being adopted in a large number of works already, and as the effect on the health of the workpeople becomes more and more apparent, there is no doubt but that in time their requirements will be applied to many more classes of business premises. What we have to do is to see

that the best possible system is adopted, so as to safeguard as far as possible our own particular interests.

The means of obtaining ventilation are very varied, and may, in the first place, be divided into two—viz., Natural and Artificial Ventilation.

In Natural Ventilation no machinery is used to distribute the air through the rooms, but it is admitted through openings at or near the floor line, becomes warmed by the heat of the room, and rises, the vitiated atmosphere being carried away by the openings at the top of the room. Artificial Ventilation is carried on by the aid of machinery, or by the action of heat, or by the two in conjunction. In what is known as the vacuum system, a fan (or fans) draws the foul air out of the rooms, the fresh air finding its way in at various openings. In the Plenum system, which is now largely adopted, the fresh air is driven into the building by a fan or fans, and the polluted air escapes by different apertures provided for it.

Atmospheric air consists roughly of about 79 parts of nitrogen and 21 of oxygen, with a trace, say 4 parts in 10,000, of carbonic acid gas. In nature the purification of the atmosphere is constantly going on, and depends on the fact that the vitiated air being warmer, and therefore lighter than the pure ascends, the pure air taking its place.

In many buildings where natural ventilation is depended on, the fresh air is admitted by tubes in the walls, and the warmed air escapes by means of the chimney or roof cowl. From a Fire Insurance view this has few objections, but as a means of purifying the air breaks down, as the foul air is not removed rapidly enough and the fresh air admitted in sufficient quantities into the rooms, and as a result the air is breathed over and over again, gradually becoming more and more impure, producing that uncomfortable close feeling with which we are all, especially those of us who travel much by train, so familiar.

Mr. Casmey, of the Blackman Ventilating Co., in a paper read at the Yorkshire College, Leeds, some two years ago, stated that under normal conditions a man passes through his lungs about 16 cubic feet of air per hour, and to maintain a proper standard of purity this would require to be diluted with 250 times its own volume, or 3700 cubic feet per hour; and according to Mr. J. D Sutcliffe, of the Sutcliffe Ventilating Co., at least 2000 cubic feet of air per hour must be supplied to every occupant of the

room to meet the requirements of the Cotton Cloth Factories Act.

Where natural ventilation is used such a result could not be obtained.

The problem of obtaining a thorough system of ventilation is not a new one. In the 16th century it was customary to ventilate mines by means of a large fire, which was suspended part way up one of the shafts, thus causing an upward draught which carried off the foul air. An arrangement on somewhat similar lines was tried in 1835 by Dr. Reid for warming and ventilating the House of Commons. In this case a fire was built part way up a brick shaft erected outside the main building, this shaft being connected by means of a flue with a chamber formed in the roof of the House between the ceiling and the slates. The fresh air was admitted by channels under the floor. When the air became warm it rose into the cavity referred to, the current caused by the fire in the shaft being sufficient to draw the air from the chamber. Previous to this, a Dr. Desaguliers had invented a fan which was worked by a handle; and in 1736 a fan of this description was placed over the ceiling in the House of Commons, a man being kept constantly at work while the House was sitting. This plan was used till 1817.

With the introduction of steam, ventilation became much more general, and many places are now fitted up with fans. These are sometimes worked on the vacuum system, at others on the plenum, and occasionally the two are combined. Figure 8 is an application of this method as adopted in a carding room, one of the dirtiest rooms in a cotton mill. In the bottom plan, in addition to the fans at the sides exhausting the air, two fans A and B are shown, which blow air down the centre of the room. In some trades where a dust highly dangerous to the health of the work-people is given off during the processes of manufacture, a number of fans is arranged below the level of the work table, and these draw the dust into metal tubes, and discharge it to the outside. Figure 9 will give some idea of how this is managed in a grinding room, and I have seen a similar arrangement in connection with the finishing machines in a boot factory. Waste willowing rooms are generally very dirty and full of fine dust, but in a risk of this kind I was at a few weeks ago the air was almost as pure as that outside. This was effected by placing over the willows a fan which drew the dust into a large metal tube and discharged it into

a dust chamber outside the main building. In another case, that of a large woodworking risk, the dust and shavings from the machines were removed in a somewhat similar way. In a flannelette raising room not very far from here, a couple of fans in the roof keep the place wonderfully clear of the light fluff usually seen in such risks. In match works during boxing a deal of smoke is given off owing to the matches firing. Figure 10 shows how this is overcome at the new match works at Irlam. Each girl boxes under a glass hood, and the fumes and smoke are immediately drawn down the back of the hood and under the table to the fan. Another fan supplies fresh air to the room, the air in cold weather being warmed.

One of the most modern examples of heating and ventilating by hot air in this district is that of the Royal Technical Schools at Peel Park, Salford. In this case, what is termed the twin-duct system is adopted. Running under the whole length of the basement of the building are two fireproof chambers placed one above the other, the upper one containing at one end a series of steam coils, supplied with steam from a boiler in a separate building. In the grounds some 80 yards away is an air shaft, connected with the building by an underground passage. The air is drawn by fans through this passage into a large chamber, passing through a special washing arrangement, and then through a large air-purifying screen or filter constructed of wire netting and coke. It is then forced by the fans, part over the steam coils referred to, where it becomes warmed and then into the warm-air duct, and part into the cold-air duct. From these ducts flues run to each room, the hot or cold air being turned on as required by the aid of a valve worked by a chain and fixed between the hot and cold air supplies. At the top of the building is another passage running all round the building, and of fireproof construction, and into this flues carrying off the fumes and foul air from the rooms below vent. Connected with this chamber is a large tower, in which is a fan which exhausts and carries away the bad air. This fan is hardly as powerful as the four fans which drive the air into the building, so that a slight pressure is maintained in the rooms and draughts from the outside are avoided. The Bury Art Gallery and Library is heated and ventilated in a similar way, and Figure 11 will perhaps enable you to grasp the system more easily. In a warehouse not a mile from this room, which is warmed by air forced

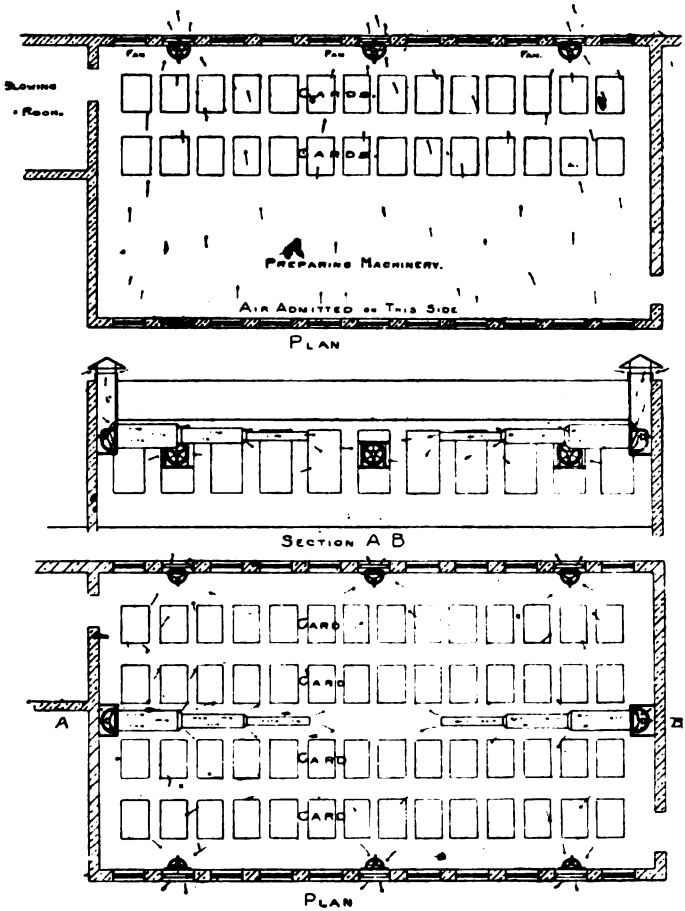


Figure 8.

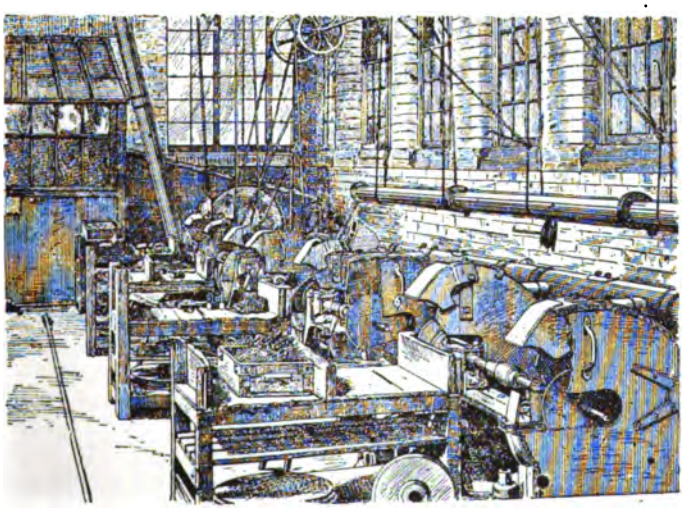


Figure 9.

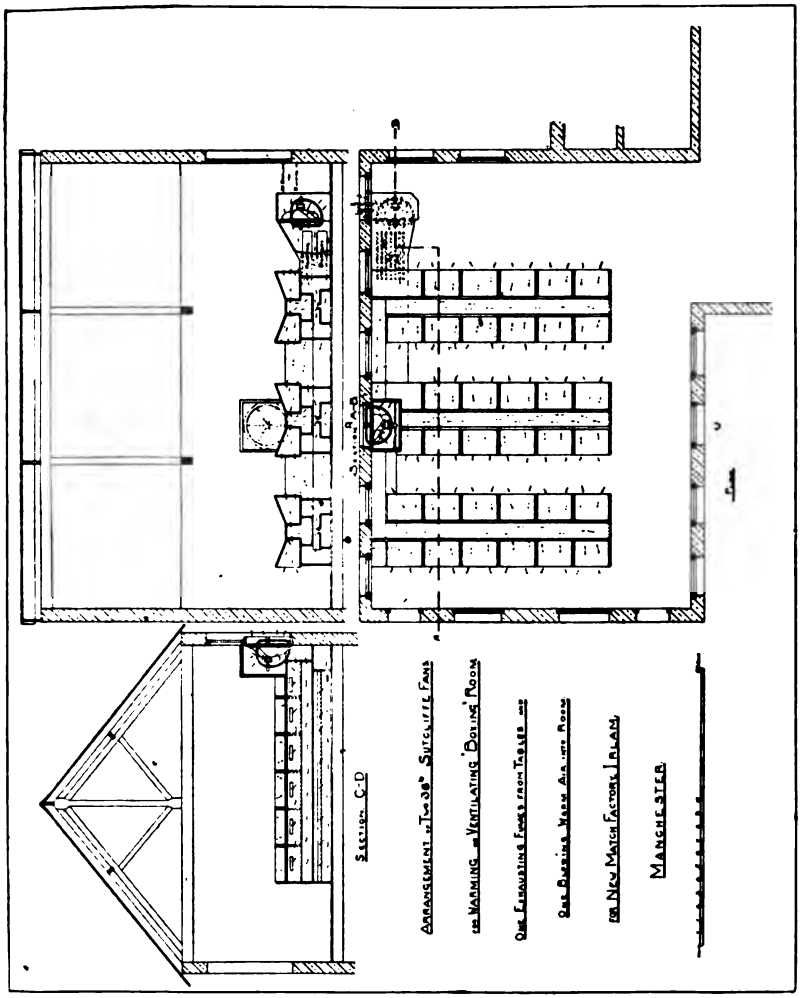

Section C-D
Arrangement of "Two 36" Sutcliffe Fans
for Warming and Ventilating "Boxing" Room
One Exhausting Fans from Tables and
One Blowing Warm Air into Room
for New Match Factory, Ireland.
Manchester.

Figure 10.

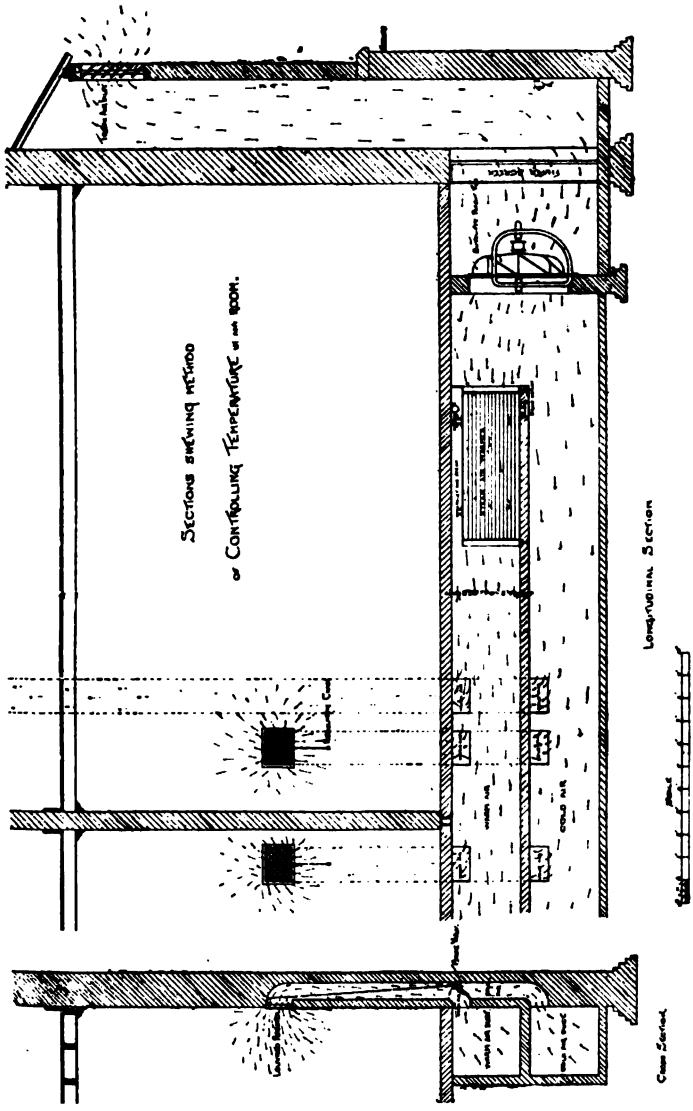

Sections showing method
of controlling temperature of the room.
Longitudinal Section
Plan
Cross Section

Figure 11.

over a furnace by means of a fan, the brick-built hoist is used as a ventilating shaft, round holes 1½in. in diameter and about two inches apart being bored in the iron doors. This certainly more or less achieves the end aimed at, but at the same time it sadly interferes with the fireproof nature of the hoist. In some cases a brick flue runs through the building, the air being admitted into the various rooms by means of gratings, which can be opened or shut as required.

In bleach and dye works where ventilation is necessary to carry off the steam, this is very often obtained by means of louvre boarding in the roof, or where the buildings are of more than one storey by ventilation shafts, usually of timber construction, which are carried through the different storeys and through the roof, and a similar arrangement is adopted to ventilate the sizing rooms in cotton manufacturing risks. In bacon and ham smoking rooms, where sawdust is burnt for curing purposes, the smoke is carried off by wood or other shoots running through the roof or into a flue.

In theatres and other large public buildings the ventilation is often aided by the heat from the large gas lights or "sunlights" in the ceiling. Ventilation shafts are provided in connection with these to carry off the fumes, the shafts also serving to carry off the vitiated air which rises from below. These shafts should be constructed of metal, and should be securely built. As a rule, between the roof of the theatre and the ornamental ceiling there is a space which is sometimes used as a store for scenery and lumber, and the shafts should be so constructed that they go straight through the roof and have no connection with this space.

In conclusion, I have to thank those gentlemen who have furnished me with valuable information on the subject, and more particularly my thanks are due to Messrs. Saunders & Taylor, of Manchester; Messrs. Renton, Gibb & Co., of Liverpool; Messrs. J. Langfield & Co., of Manchester; and the Sutcliffe Ventilating Company, of Manchester, for the use of blocks from which this paper is illustrated.

WM. SUTCLIFFE.

Insurance Association of Manchester,
January 17, 1901.

FIRE INSURANCE PLAN DRAWING.

THE career of Surveyor to a Fire Insurance Office is one of the most responsible upon which a young man can enter, for upon his sharpness of perception, attention to detail, and ability to discern and describe the salient features of the risk which he is called upon to inspect, may depend not only the mere rating but the acceptance or declinature of the business offered. The latter, in turn, may involve not merely the possibility of profit or loss to his Company, but an injustice to the proposer, either through an exaggerated estimate of the hazard, or inability to gauge the eligibility of the risk.

Like matrimony, it is not a thing to be entered upon "unadvisedly, lightly, or wantonly," for it would be hard to find any business—call it profession if you will—in which a more thorough all-round knowledge is more essential than that of a Fire Insurance Surveyor. The services of the idler are never wanted, and anyone who imagines that a thorough knowledge of the business will be picked up between the hours of 10 and 5 had better go and play at something else. It is a cheap fallacy for a man to say that so long as he gives his employer the stipulated time and service the remainder of his life is his own to do with as he pleases. The man whose efforts are not continually directed towards self-improvement, and towards the rendering of a better and increasingly valuable service, must inevitably fail.

Without professing to be an architect, the Surveyor should know something of building construction and design—be able to point out defects and suggest suitable remedies and improvements; without being a lawyer, he should know something of law, at all events as regards Insurance questions; he need not be an electrician or a chemist, but he should understand something of electricity and the latent properties of various substances capable of

development under certain conditions—be able to show (to give a very elementary example) that to wrap up newly-burnt lamp-black in printed paper is only a temptation of Providence, and that Providence sometimes declines to be tempted in vain. These, together with at least a theoretical acquaintance with the trade processes of his district, may be termed the mechanical part of the stock in trade of a Surveyor, by which is meant that the fundamental principles involved may be acquired by careful study. There are, however, certain other qualifications which must come naturally. Patience, tact, and a good memory cannot be acquired, although much can be done to assist their development. The Surveyor must be methodical and should have an analytical mind with, perhaps, more than a tinge of scepticism in it. He must not accept as gospel everything he is told; but, on the other hand, he must not make the fatal mistake of acting too literally on the Psalmist's dictum that "all men are liars" by believing nothing. Keen and accurate powers of observation are absolutely essential, for the Surveyor sees things in groups, and must learn to select the important and necessary, from the mass of irrelevant and superabundant details. He must not jump at conclusions, but think logically and quickly. Even the best Surveyor will make mistakes at times, but the man who most frequently goes wrong is the one who cannot trust his own opinion, but chops and changes his views until he ends in a state of hopeless chaos.

The object of a Fire Insurance Survey, of which a plan as a rule forms an integral part, is to ascertain the precise situation, construction, occupation, communications, and surroundings of the buildings proposed for insurance, together with such other particulars as are required to present in a fair and adequate manner an idea of the risk which the Office is asked to accept. In addition to this the Surveyor should carefully study the character of the proposer, as the moral hazard is by no means a negligible quantity in gauging a fire risk, although I am aware that many people consider this to be the duty of the Branch Manager or of the Agent introducing the business.

A plan is usually drawn where the buildings to be insured are at all numerous or of an involved character, but as the requirements of the various Offices differ considerably in this respect it would be futile to attempt to refer to this point in any but the most general terms. I have heard of a maxim frequently given to

beginners playing whist, "When in doubt lead trump," which I would parody for the benefit of the young Surveyor, "When in doubt draw a plan." If the risk, then, is one which calls for a plan, it will generally be found desirable to finish the drawing before proceeding to note the description of the various buildings. As a rule, although it is not always possible, it will be found advantageous to dispense with the services of a guide, at all events during the preliminary operation of drawing the plan, when all conversation should be avoided. The Surveyor can then take his own time and devote his undivided attention to his work without the necessity of having to discuss the weather and the crops with his escort, who may possibly be his client in person. In this way the Surveyor will be able to number or letter his plan—the first is generally preferable—in such a way as to enable him to take particulars of the different buildings in a consecutive manner without confusion.

When sketching the buildings, the use of sectional paper will be found to be a great saving not only of time but of trouble, for errors in measurement or in the relative position of buildings are more likely to make themselves apparent than if plain paper be used. Sectional paper, or plan paper as it is sometimes called, is ruled off in small squares, usually $\frac{1}{8}$th, $\frac{1}{10}$th, or $\frac{1}{16}$th of an inch square. Each section may, of course, represent whatever number of feet to the inch may be thought most suitable. Thus, in drawing to a 40-foot scale, the above squares would represent 5, 4, and $2\frac{1}{2}$ feet respectively, and so on according to the scale selected. If, on the other hand, plain paper is used a scale measure would be indispensable in recording each measurement, thus creating a considerable amount of extra work; or the still more cumbersome method might be adopted of noting down in figures each individual measurement—a system which, in my opinion, will speedily condemn itself.

At important points, or in very complicated works, it may be necessary to make use of a measuring tape, but a little practice will enable the Surveyor to measure with wonderful accuracy by merely pacing the distance. If the Surveyor is tall enough to pace a yard with ease, it is a good thing to make a practice of doing so when measuring; but those who cannot do so will find it much better to ascertain the length of their normal stride and adhering to it, make their calculations accordingly. There is one

point which is frequently overlooked, even by Surveyors of some standing, in pacing buildings standing on sloping ground. It must be remembered that not only does the pace vary in length according to the slope of the ground, but a correction must be made for the horizontal projection of the distance. Going down hill tends to lengthen the stride, and the horizontal projection minimises the error; but in going up hill the stride is shortened, and the error is aggravated by the projection. Whether it is defensible on scientific grounds or not, I would not like to say, but for all practical purposes one gets sufficiently near the mark by pacing the distance both ways and then halving the total number of paces.

Just as the art of swimming cannot be learnt without actually entering the water, so the knack of measuring buildings can only be acquired by doing it, for it must be borne in mind that such a study as this is one in which the student will require, to a large extent, to be his own teacher. When, however, the Surveyor has mastered a few elementary principles the necessity of applying them will in itself show him what method to pursue.

The key to all Insurance plan drawing is to be found in the geometrical axiom, with which those who have still some glimmering recollection of the works of a gentleman called Euclid, now deceased, may possibly remember, that to describe a specified triangle three data are necessary. These data may consist of (1) three sides, (2) two sides and the contained angle, or (3) two angles and the common side. This last may, however, be set aside as useless for the purpose at present under consideration. Now, to draw the plan of a building or a number of buildings, especially when these are irregular in form or in situation, necessitates a series of triangulations the apices of which will be the required points which it is desired to locate. It will no doubt comfort the tyro to know that in actual practice operations are greatly facilitated, and the necessity for triangulation to a large extent lessened, by the fact that in the majority of cases buildings are rectangular or at least in the form of parallelograms, and only in a few odd cases will he require to work out the four corners of a building.

These triangulations to which I have referred must, of course, be made from a known base, but their actual operation will be explained presently.

Another bit of Euclid which I should like to bring back to your recollection is that the opposite angles formed by the intersection of two straight lines are equal.

Although we are so accustomed to hear that experience teaches all things, I make no apology for indulging in what is, perhaps, a somewhat stilted and pedantic exposition, for in Insurance plan drawing as in all other technical subjects there is a danger of a student's following the convention or "rule of thumb" and ignoring altogether theoretical training, which is essential to an intellectual knowledge of his work.

Let us now look at Diagram I., which represents a group of buildings of which, for the sake of example, we will suppose it is necessary to draw a plan. Taken as a general rule all measurements are taken from the outside for the sake of facility of getting about, but cases will be met with where, for various reasons, the outside walls are inaccessible, or the yards are so crowded with goods and lumber as to render it almost an impossibility to get accurate exterior measurements, in which case there is no option but to fall back upon internal measurements. The method of making these, however, is very similar to what I am about to describe, but with this difference, that to the internal measurements must be added the thickness of the walls.

In the chapter on Surveying in Hare's "Fire Insurance Manual," which, I may parenthetically remark, is practically identical with a portion of the "Instructions to Agents" issued by the long defunct *Northern Counties of England* Fire Insurance Company, its author says:—

"In commencing to take a plan, the first thing is to measure "the longest straight line of wall or building, or when there happens "to be no sufficiently long line of wall or building, an imaginary base "line should be taken, such as will enable you to measure with "the greatest facility into the various points and angles of a long "line of buildings."

Now, if a Surveyor knows what he is doing these directions are admirable, but one can picture a junior in that state of nervous apprehension which I think I may safely say all Surveyors have at some time or another experienced, wasting his time trotting round trying to ascertain the longest building from which to start, or seeking in vain for some soft spot in a street or factory yard in which to plant the "small pieces of stick" which Mr. Hare

goes on to recommend. The great thing is to make a beginning, it really does not matter much from where, and then go ahead slowly and accurately, taking one building at a time, and not bothering about any other building than the one on which he is immediately engaged. Right angles being easier should be taken before trying to work out acute or obtuse ones.

We begin, then, by drawing the street front, *a b*, 170 feet in length. at the bottom of our plan paper, ticking off as we go along the position of the doors, gateway, etc. Then, as you will notice that the wall towards the river is at right angles to the front wall, it is drawn next, but as we cannot measure it it can only be roughly worked in to start with. Then try the Princes Street corner, where we are faced with an awkward acute angle which we will get by an application of method 2. Get your shoulders square against the wall at *b* and walk straight across the street, which you find to be 40 feet wide; then do a sharp left turn, and pace carefully till you can just see the corner *e* appearing past *b*, make a dot on your paper at *d*, which you find is 5 feet from *c*, and draw a line of indefinite length from it through *b*, and your first angle is worked out. Since we are in the street, at any rate, we may as well get the length of *b e*, which we will find to be 145 feet, after which we go back. Look at the roof from the street and from the yard and you will find it unbroken; so, to get the depth of the range, we go through the cartway and find that this latter is 40 feet long, so draw your line *h i*. Now, as we have already ticked off the gateway *f g*, we can draw in the lines *f j* and *g k*, indicating that it is a gateway by a cross. Then we find on your left a small gate office, 12 feet 6 inches by 22 feet 6 inches. This runs up against the two-storey building at right angles, so after putting it down we can indicate the line *l m*, and then, measuring the 22 feet 6 inches from *n* to *m*, we can draw the line finally, also the end wall of the building which we can see over the roof of the shed running at right angles. In a similar way the sheds are drawn in until we reach *o*, a point in the wall running alongside the river, and which you will remember drawing in at the commencement.

This reference to right angles reminds me that if ever you want to ascertain if one wall runs at right angles to another the way to satisfy yourself is very simple. Take your tape, which I am presuming you carry in case of emergency, and measure from the

junction 3 feet along one wall and 4 feet along the other, making a mark at each point. Now, if the distance between these two points is exactly 5 feet across, then it must be a right angle.

As we have now no more right angles, we go back to *k*, and measure from *k* to *p*, 60 feet, which gives us the depth of this unknown three-storey building. Then, as we see that the front and back walls run parallel as usual, we can draw the line of wall *p q* To make quite certain of this angle you can apply method 1, measure, say, 20 feet from *p* towards *k* and *f* from *p* towards *q*; then measure between these two stopping places and compare it with what you have already on paper.

At this point I may as well show you another alternative method of obtaining the same result. You have already settled the position of the wall $m\ m^1$, so walk up the side of the wall *p q* until you can just see m^1 past *m*. Then measure from this point to *m*, which you will find is about 93 feet. This method used in conjunction with any of the others is excellent as a cross check, if not for its own sake.

By looking at the roof we see that the wall *q e* is at right angles to *p q*, and our plan should show the same. Now we have to work out the angle *p q r*. Starting from *q* in a continuation of the line *e q*, we pace on until in a line with your right shoulder you see the corner *r*. Then stop and mark the spot *s*, do a right turn, and note the distance from *s* to *r*. Join *r q*, and there you are. Now to get angle *r t q*, *r q* we already know, so apply method 1 and measure *r t* and *t q*. As the building is rectangular, all we have to do is to measure the length of *t u* and *u v*. The wall *v w* being parallel to *t x* may be drawn in without measurement, as also may *t w*. It so happens in this case that *w e* is parallel to *r q*, but if you wish to check the angle *v w e* select a point *x*, which may be anywhere in a straight line with *v w*, and measure at right angles to it until you come to the wall *w e*.

To locate the position of the detached building, measure *u y* and *y t*—*t u* we already know—and get the position of *z* in a similar manner by triangulation off the shed which we have already drawn. Then measure the sides, after which we can go into the various buildings to mark in partitions, party walls, communications, boilers, and other details.

In order to avoid confusion, I have thought it better to

omit from this plan buildings with curved walls, which are occasionally, but not often, met with. These require a somewhat peculiar treatment, to understand which it is necessary to know how to describe a circle passing through any three given points. Let *a b c* be the three given points through which the circumfer-

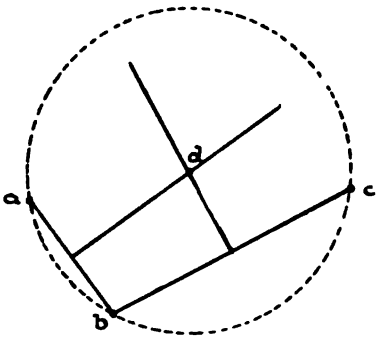


Diagram II.

ence of the circle must pass. In order to find the common centre, join *a b* and *b c*, bisect each line, and on the side of the lesser angle draw two lines of indefinite length at right angles to them. The point of their intersection, *d*, is the spot with which as centre, and *d a*, *d b*, or *d c* as radius, the required circle can be drawn.

Now for the practical application of this theory, first with a concave and afterwards with a convex curve.

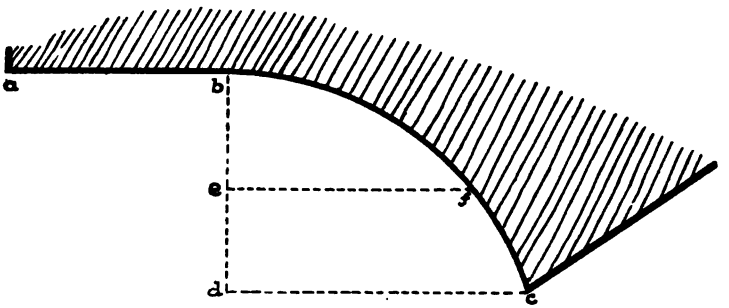


Diagram III.

From *a* to *b* the wall runs straight, and thereafter takes a curve to *c*. First of all, *a b* is located, and the angle *a b c* is worked out by measuring from *b* at right angles until you come to *d*, a spot on a level with *c*. Note this point on your paper and measure from *d* to *c*, which you mark. Then start as before from *b*, and measure any distance you like between *b* and *d*, say to *e*. Turn at right angles as before, and measure from *e* to the wall which you meet *a* and the point *f*. Now find the centre of the circle whose circumference passes through the three points *b f c* by applying the rule given in the last paragraph.

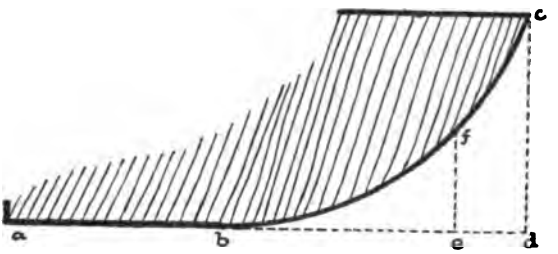


Diagram IV.

Here we have a convex *b c* springing as before from a straight wall *a b*. (This straight bit of wall shown in Diagrams II. and III. is not indispensable, but is inserted simply to show the method of procedure more clearly.) Locate as before *a b*, and in a straight line with them find the point *d* at right angles to *c*, then measure to *c* similarly, take any point *e*, measure *e f*, and describe your curve *b f c* as in the last example.

Having now got the dimensions of the various buildings and their relative positions safely committed to paper, the Surveyor's sketch will probably look something like Diagram V., and this brings us to the consideration of the next step—the finished plan.

For the material on which the finished plan should be drawn I am strongly in favour of tracing cloth. Paper nowadays has a reputation somewhat akin to that of a sausage—you never know what it is made of—and as plans have to do duty for years it is most disheartening to see them cracking at the folds and dropping to bits. Tracing cloth, however, stands any amount of rough usage and constant handling in a way which nothing else will that

I have come across. Personally, I always draw on the wrong or rough side of the cloth, as I find it easier to make the ink flow smoothly, and, if a slight mistake is made, a sharp knife or a damp cloth effects a speedy clearance.

So far as ink is concerned, I would recommend good Indian ink, or Stephen's or some such ebony stain, which, although more especially intended for application to woodwork, is no less effective as a drawing medium, for which reason it is frequently made use of by illustrators for the press.

Then the scale upon which the plan is to be drawn must be decided upon, as it is at once evident that the larger the scale the clearer will be the plan and the greater the possibility of inserting minor details. Economy and convenience call for a small one, efficiency for a large one. The question thus resolves itself into what details can be omitted without affecting the utility of the plan. The prevalence of the scale of forty feet to one inch seems to indicate that the united experience of Insurance men in various centres has proved this scale to meet the requirements of most cases, although instances will be met with where a 20-foot scale will be required, while, where the buildings are large and present no special features, a scale of even 100 feet to the inch is not too small. Only experience will enable the Surveyor to settle the matter for himself.

When considering the scale to be adopted it is important to remember that areas are in proportion as the squares of lineal measure; thus a plan drawn to a 20-foot scale covers four times the area of one drawn to a 40-foot scale, not merely double.

After the scale has been fixed the marks to be used in drawing the buildings must be decided upon, simple signs which will in themselves speak—for, after all, is not word a symbol?—and be readily capable of being understood without reference to appendices, footnotes, or explanatory remarks, and which should be uniformly adhered to in all plans. In many respects it is to be regretted that the Fire Offices have not adopted some uniform or authorised system of plan drawing, for to look at some plans it is impossible to differentiate between a perfect party wall, an imperfect party wall, and a partition, or between the exterior walls of a building and the mere boundary fence of the yard. I have therefore compiled an alphabet of signs which is, I think, sufficient for all practical purposes, and the actual use of which

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will be seen in Diagram VI. To attempt too much in this direction is likely to lead only to confusion, hence the simplicity of the signs proposed.

It may be as well to remark that the thickness of the walls is not, as a rule, drawn to scale, and the same may also be said of doors and window openings. It is unnecessary to show windows unless these overlook or are so near those in a neighbouring building as to be a possible source of danger in the event of a fire. It is frequently an important factor in deciding as to the acceptance or otherwise of fire risks to be informed of the existence of other buildings in dangerous proximity, but it is very difficult to lay down any hard and fast definition of that term for the guidance of the inexperienced. What constitutes "dangerous proximity" depends not only upon their relative positions, opposing openings, etc., but upon various other circumstances, such as height, the materials of which the buildings are constructed, and the trades carried on or the goods stored therein. Perhaps, in case of doubt, Sir Eyre M. Shaw's rule that two buildings are within risk unless they are separated by a space equal to at least half of their combined heights might safely be adhered to. To show all the windows in a factory may possibly make the plan look very nice, but it takes very much longer to draw, and, after all, is of no practical use. Remember that plans are meant for use, not ornament, and that unnecessary details had best be omitted.

When a fireproof building, or group of buildings, forms part of a survey, an excellent idea, which is adopted by several Offices, is to draw on the margin of the plan a cross-section of the fireproof block.

In numbering the various buildings, what further recommendation can I make than that they should be numbered consecutively clockwise, taking in stragglers last?

A very handy method of indicating height is to mark in small figures in the top left-hand corner of each building the number of storeys.

The occupation and relative positions of the surrounding risks are, as has been indicated above, absolutely essential. In such a risk as a whisky bond or an oil mill or store, the fall of the ground should be noted, as burning whisky or oil are hard things to stop when they once get on the move, and are practically inextinguishable.

In foreign countries, where the prevailing wind is an important factor, the use of "compass points" is practically universal, but I have been unable to ascertain any adequate reason for their use in this country, although many Surveyors adhere to the practice.

The addition of the name of the firm, name and situation of the mill or factory, not forgetting, of course, to mark the scale to which the plan is drawn and the date of survey, completes the drawing operation.

Having finished the plan, the next consideration is whether it should be coloured or not, and if the former, what system of colouring should be adopted. Some Surveyors are in the habit of colouring their plans to indicate the number of storeys. For instance, red may mean one storey in height, yellow two storeys, blue three storeys, and so on. Others again follow Goad's colouring—*i.e.*, according to the construction of the buildings. However, in following the system advocated here, it will be seen that the plan of the buildings in itself indicates their construction with the exception of the roofs, the nature of which is all that it is necessary to show in colour, and this can easily be done without fear of confusion. *Red* (crimson lake) may be used to indicate slates or tiles; *yellow* (yellow ochre), timber or felt; *blue* (ultramarine), corrugated or sheet iron or zinc; *grey* (Indian ink and water), concrete, asphalt, or tercera; and *green* (emerald), thatch. If the Office to which the Surveyor is attached requires all roof lights to be shown, the sign used by Goad for roof lights in a building over two storeys in height—*i.e.*, a dotted line coloured *purple*—is the best, and this colouring will also be useful in indicating glass-roofed yards.

The secret of good tinting is to begin by making up a quantity of wash sufficient to colour the whole plan. Do not let the drawing board on which the plan is pinned lie flat, but slope it like a desk. Then with a brush always filled with colour begin at the top left-hand corner and gently float the colour from left to right and downwards, finishing at the bottom right-hand corner, where any superfluous paint can easily be removed with blotting-paper or with the brush. If the paint is made too thick or the brush is not constantly full, unsightly brush marks will result, which will give an unfinished appearance to the plan.

If the plan is drawn on cartridge-paper, the colouring is, of

Exterior wall or perfect party wall.

Imperfect party wall (*i.e.*, coming up to but not through the roof).

Stone or brick partition or boundary wall.

Main wall showing windows.

Do. do. overlooking.
(The windows are drawn on the side of the building which is *overlooked.*)

Main wall showing doorway.

Main wall showing doorway protected by single fireproof door.

Main wall showing doorway protected by double fireproof doors. (These signs used in conjunction with the sign for windows indicate fireproof shutters.)

Timber or lath and plaster partition, timber building or boundary fence.

Corrugated iron building or boundary fence.

Building open on ground floor, the upper floors being carried on brick or stone pillars or iron columns (shown alternately).

Archway.

Hoist. Open (guide-posts only.)

Hoist. Wooden.

Hoist. Brick.

Horizontal Boiler (the end drawn square indicates the firing place).

Vertical boiler.

Stair.

Water wheel.

Roof light.

Hydrant.

Chimney.

Building adjoining property insured.

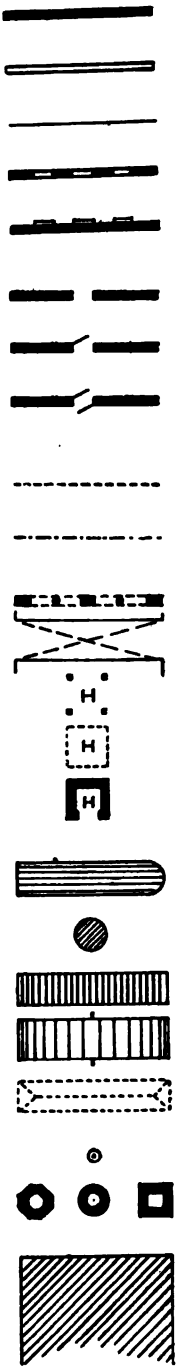

Diagram VI.

course, done on the face, but when tracing cloth or paper is used the colouring is done on the back and shines through, brush marks in this case being much less apparent.

The Surveyor will now have a finished plan, giving prominence to certain facts which will form the foundation on which he can start his report, and I look forward to seeing this subject of reports dealt with in due course in a future volume of the Journal of the Federated Institutes.

PAT. B. CARPHIN.

Insurance Institute of Ireland,
March 8th, 1901.

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POTTERIES.

PART I.—HISTORICAL.

IT would, doubtless, be impossible to ascertain when and where the first "potter" lived, but records of the potter's art have been traced back into the remote ages.

It is evident from history that both in the new as well as in the old world many of the ancient nations were familiar with the manufacture of pottery—the Egyptians and Chinese coming first, followed by the Assyrians, Babylonians, Greeks, Romans, early Britons, and Anglo-Saxons.

The potter's wheel is, with perhaps the exception of some of the utensils of agriculture, one of man's oldest implements, and ancient illustrations demonstrate its existence nearly 2000 B.C. I have not, however, been able to trace whether its invention was due to the Egyptians or the Chinese, but it is quite clear that the potter's wheel of to-day is almost the same in construction as that of nearly 4000 years ago.

Although almost every part of England has been able at some period to claim pottery as an industry of its own, North Staffordshire is essentially the home of the ceremic art, and it is interesting to know that the same bed of clay which to-day produces materials for aticles of daily use, supplied 1500 years ago the clay for the table vessels of the inhabitants of the then great city of Unicorium.*

Professor Jewitt tells us that in the excavations which have been undertaken on the site of this now ruined city, immense quantities of fragments of pottery have been found, and that it is not too much to say that, with the exception of Samian and Durobrivian ware, the whole of the said pottery was made in the Severn Valley.

* Wroxeter now stands on the site of the old city, about 21 miles from Shrewsbury.

The seat of the china and earthenware manufacture consisted some 100 years ago merely of several detached hamlets, with a few isolated pottery works. "The Potteries" of to-day, however, which comprise the towns of Longton, Fenton, Stoke, Hanley, Shelton, Etruria, Vale Pleasant, Cobridge, Burslem, Longport, Tunstall, Brownhills, and Goldenhill, include a district almost twenty miles square—a restless, prosperous centre of industrial life—the germ of which lies so far back as to be almost untraceable.

In endeavouring to trace the origin of the art in this district we have to go back to pre-historic times when the Cornairi—a warlike tribe which made pots on the banks of the Tiber—for some strange reason travelled to this country and settled in Mid-England, and carried on their old craft. Since that time pottery has always been a Midland industry.

Dr. Shaw says that Burslem must have been noted for pottery in Saxon times, because the modern name of Burslem is derived from the Saxon "Bwlwardeslœm" (which in English would be "Bowl-quarry-loam," or, more fully, the spot where loam is quarried and used for pots), and that there are documents in existence which imply that during many centuries considerable quantities of common culinary articles were there made.

We find that the Staffordshire potters, including a certain Thomas Wedgwood, jogged along in a quiet manner until the year 1690, when two brothers named Elers appeared upon the scene. The advent of these two German emigrants had an immense, though not immediate, effect on the future productions of Staffordshire potters. They settled at Bradwell Wood, near Burslem, where the fire-clay was well adapted to the ware they made, and in this secluded spot they carried on their craft with the utmost secrecy, employing the most stupid people they could find, and locking them up whilst at work, always reserving the finer parts for their own manipulation in secret. They managed to produce ware so superior in body and finish to any hitherto seen in the Potteries that a not unnatural curiosity was aroused, and a Burslem potter—Samuel Astbury—resolved to discover their secret. The story runs that he disguised himself, and pretending to be half an idiot obtained employment at Bradwell Wood. He affected such ignorance and indifference that he was allowed to watch the various processes and to make himself absolute master of the Germans' art. With this "acquired"

knowledge, added to his previous individual experience, he became one of the accredited (as he was one of the earliest) scientific potters, and was untiring in his experiments.

To trace in detail the rise and progress of the manufacture, and to particularise the successive developments from rough ware, as produced in the earliest days, to the almost priceless productions of to-day, together with the presenting of details of the successful parts played by such men as Astbury, Josiah Wedgwood, and others, who may be said to have vitalised, nursed, and fostered the industry, could not fail to prove interesting if time permitted.

PART II.—PROCESSES.

Body. Earthenware generally comprises:—(1) Blue or ball clay. (2) China clay. (3) China stone. (4) Flint.

China stone and china clay are both found in Cornwall. The former is sent to the potteries in its crude state, but the clay is prepared before it is despatched, being washed free from mica and other impurities.

The Flint Mill. Here the stone and flints are ground by the "Millers." It is done in water in a large vat fitted with upright shaft (revolved by power) to which are attached four large arms. These arms each push a heavy block of stone round and round the vat, the bottom of which is paved with the same stone, and these blocks do the grinding. As you are aware, flint mills call for no special comment, being (under Section V. of the Potteries Tariff) rated at 3s. per cent. without any "extras."

Slip House. The different materials which go to make up the body of the ware are here ground and mixed with water in separate pans to form what is known as "slip," which is of the consistency of cream.

There are generally four large pans in a modern slip house. Two of the pans are used for mixing the clay, and two are used for storing the stone and flint which come prepared from "the mill."

The clay-mixing pans are known as "Blungers," and are each fitted with an upright shaft, with arms or blades fixed to it,

which are revolved by power, and are somewhat similar to those in the flint mill. In the mixing the blocks of clay are thrown in front of the arms with a quantity of water, and it does not take long for the "Blunger" to work up the clay and water into a thick liquid.

There is a pipe from each of these four pans, connecting them with a large mixing tank sunk below the floor level, and into such tank the requisite amount of the contents of each of the four pans is allowed to run to make up the required "body."

The mixing tank has upright sides, and for the respective body required the proportionate number of inches of each material is run into the tank. Thus, for an earthenware body there might be used—

14 inches of Ball clay.
11 inches of China clay.
7 inches of Flint.
4 inches of Stone.

Manufacturers, however, vie with one another in the making of the "body," and their own individual manipulation of the ingredients is kept secret—each claiming superiority for his particular system.

The four ingredients before referred to are well stirred up and thoroughly incorporated in the mixing tank, and then the liquid is pumped into the clay presses, which consist of several canvas bags, each of which is fixed on an iron, or wooden, frame. On its way the "slip" passes through a box of magnets, which clear the liquid of all particles of metal which may be in the "slip."

Now, as the pump is not yet stopped and the bags cannot get any fuller, the water is automatically pressed out through the pores of the canvas, and the clay is left within.

When all the chambers have been filled with clay the pump is stopped, the frames unfastened, and the masses of clay removed. The clay is then worked through a pug mill to compress it into a uniform mass, when it is quite ready for the potter.

Throwers' and Turners' Shops.

The "potter's wheel" consists of a circular disc or table, about 14 inches in diameter, which is fixed on a spindle, so as to revolve at the least touch.

The "thrower" usually has two assistants, one to cut himself clay in suitable lumps and place it ready to his hand, the other to

carry his work away as he finishes it. He sits in an elevated position at the back of and above his wheel, so that his hands are free to enable him to readily manipulate the clay.

It is most interesting to watch the "thrower," and see how quickly a lump of clay can be manipulated in a variety of ways. He first throws a ball of clay into the centre of the wheel, and this movement is called the "setting." Secondly, whilst the wheel is rapidly rotating the man lays hold of the clay with his two hands and shapes it into the form of a pyramid. Then he rapidly drops it again to the level, and once more lifts it; this is called the "rising," and is to secure uniformity in the mass of clay.

The next (or third) manipulation is that of "back handing"—so called from the fact that, to the observer, only the backs of the two hands are visible. The fingers of the right hand are thrust into the pliable mass, whilst the left hand is firmly pressed against the side, and before one has time to speak a cylindrical form is produced. The left hand then forces this in an upward direction and makes the figure extend, whilst the fingers of the right are kept inside to preserve its roundness.

The fourth movement is that of "coursing," the object of which is to elongate the figure.

For the satisfaction of an exigent market the "thrower's" work must be finished by the "turner," and so much so is this the case that the term "thrown and turned" is recognised by all manufacturers as if describing a single process.

The "turner," on receiving a piece of work from the "thrower," fixes it to the "chuck" on his lathe (which is almost precisely similar to a wood-turner's lathe), and skims the surface true with an iron tool. It is his duty to form the foot of a cup or slop-basin, to smooth the outside, and to round the edge, so that it only remains to add handles to the pieces requiring them. When the handler has done his part the ware is ready for the "green house" prior to going to the ovens.

The "turner" sometimes also imparts what are known as "slip" decorations.

Modelling and Mould Making.

Upon the order being issued for a new vase, bowl, or plate, the "modeller" has first to produce a design on paper. This includes not only the plain form but all details of embossment, handles, spouts, feet, or whatever accessories there may

be. This design having been approved the artist makes his model in clay, and in order to allow for the contraction caused in "firing," he constructs it about 1-12th larger than the intended size of the finished article.

The first process in making the model is called "building up," and when the artist has obtained the necessary form his attention is given to the embossment or carving out. In an elaborate model twenty or thirty moulds of the separate parts may be necessary, and each of these parts must be relegated to its proper place in the model. The maker arranges all these parts before him, and proceeds to fit and join them accurately together, which he does with a little "slip" or clay.

When the model is finished a plaster-cast is taken of it. The first mould which is taken off the model is called the "block mould," and is retained as a stock pattern for the purpose of making cases to produce new working moulds as they are required.

Pressers' Shops (Flat and Hollow Ware).

The "presser" is the name given to the man who makes his ware by pressing clay into a mould. Plates and the like are known as *flat ware*, and jugs, bowls, tureens and the like as *hollow ware*.

Inside the pressers' workshops are a range of cupboards or inner rooms (generally constructed of timber) used for drying, each of which is fitted with shelves and heated by steam pipes or pipe stoves. As the ware is made, and before it is taken out of the mould, it is placed in the drying rooms and allowed to stand there for a short time to partly harden.

All hollow ware is made on one principle, but the number of parts varies for the different articles. For instance, there would be five parts to an ordinary jug, *i.e.*, three for the jug and two for the handle. The three parts of the mould for the jug, each containing its clay formation, are put together, and bound tightly round with a strap; clay is then rubbed in the crevices where the three parts of the mould meet, and this has the effect of making the piece complete.

In making handles clay is pressed into one part of the double mould, and the two parts are then pressed tightly together.

The several parts are then taken into the drying rooms, or stoves, and in about half an hour (when both the jug and the

handles are taken out of the moulds) the handles are fastened on to the jugs by means of a little "slip."

Forming part of the "pressers'" department is the "jollying shop." Under the old process plates were formed by hand on a mould fixed on the top of a wheel, but now thousands of plates and saucers are made by a machine called a "jolly," which has been made automatically effective, to the displacement of the "thrower." This machine consists of four parts, two revolving heads and two strong iron arms. One of these heads, with its attendant arm, is devoted to making "bats" or "pancakes," to be eventually evolved into plates or saucers.

The workman takes a ball of clay and places it upon the centre of the "head," when the arm descends and spreads out the clay into a circular bat. This the man now lifts and lays it upon his mould, just as if he were about to make the plate by hand, but after a slight pressure he seizes the second arm, to which is affixed a profile, and brings it down upon the mould. The plate is thus formed as if by magic, and the insatiable machine is ready for another.

Cup moulds are set beneath a series of automatic arms, and while the moulds are revolving a ball or "bat" of clay is thrown into each. The "jolly," furnished with a tool of suitable shape, plunges into the soft ball and forces the clay up the sides of the mould until it takes the form of a cup. Then the arm rises, the cup is removed, and another "ball" put into its place.

The dish-maker proceeds in much the same manner as the plate-maker as regards his mould and his clay, but he is necessarily slower. The bat being placed on the mould, his whirler is revolved gently by hand, so that he may have time to adjust the clay to the oval shape of his dish.

The drying closets, where the saucers, etc., are put to dry, are furnished with revolving shelving, known as "dobbins," to accommodate a great number of moulds. Each time a fresh set of moulds is placed in the closets a similar number, which have just been thoroughly dried, are taken away to the "oven-man," thus liberating the latter moulds for further use.

Where stamping machines are employed for making stilts, spurs or tiles, oil is used in the process, and this is where the extra charge of 1s. per cent. prescribed under the Potteries Tariff for oil used for any process of manufacture is applicable.

Casting. This is the making of ware by pouring liquid slip into plaster of Paris moulds. Only the most delicate and beautiful ware is made in this way, the process being so expensive.

After the slip has been poured into the mould it is allowed to stand for an hour or two, when a sufficient thickness of clay will have adhered to the plaster mould, and the remaining liquid is poured off, leaving a delicate figure of clay.

Sagger Making. Saggers are cases made of common fire clay in which the ware is fired whilst in the "biscuit" and glost ovens.

The clay is first prepared in a pan mill, then beaten out into a cake about an inch thick, and then formed into an oval or round shaped vessel or drum, which is first allowed to slightly dry before being fired in the oven. The supply of saggers is kept up by placing a few in each oven before it is fired, and the ware which is placed in the saggers is kept in position by means of sand or ground flint.

Ovens. A great part of the charm and nearly all the risk of the potter's work is found in the ovens, as the tender clay pieces must be subjected to a fierce heat. Without the fire no quality could be attained and the clay would never lose its original nature. What wonder, then, that the potter regards his kilns as the most important department of his work, and watches with jealous care over the results of his firing? Pottery ovens or kilns are divided into three classes, the "biscuit," the "glost," and the "enamel." The biscuit oven is that in which the ware is changed from clay to "biscuit." It is generally cone-shaped, and sometimes there is an inner oven with a space of about three feet between the inner and the outer cone (when the outer cone is known as the "hovel"), and sometimes the two are built close together. It is built of the best fire bricks, about 2 feet thick, and is pierced at regular intervals with from 8 to 12 firing places, the heat and smoke from which are drawn upwards over the saggers. In the saggers (the construction of which I have already explained) the ware is placed to protect it from the fire and smoke, and they are put one above the other inside the oven. Thus the oven is filled with columns of saggers which columns are known as "bungs." The doorways are now built

up (clammings), and the process of firing, which takes between 48 and 60 hours, is commenced; afterwards the clammings are pulled down, and in about three days the ware is sufficiently cool to be removed. The premature removal of these "clammings" is sometimes the cause of fire.

Glost ovens are used for firing the glaze which is applied after the ware has passed through the biscuit oven, and enamel kilns are those in which gold and colours are burned into the ware.

Biscuit and glost ovens generally attain a heat not exceeding 2500 and 1900 degrees Fahrenheit respectively, whilst the enamel kilns do not exceed 1400 degrees.

Biscuit Warehouse. When the "biscuit" ware is removed from the oven it is taken into the "biscuit" warehouse to be examined and cleaned, and those pieces which require no decorations are sent to the dipping house, whilst those which are intended to be printed are handed to the printers.

The Printers' Shop. The process of transfer-printing is extremely interesting on account of the many details to which careful attention has to be given. The copper, the paper, the press, the oil, the colour, and the ware must all be in proper condition if fine work is to be done.

The "Printer" mixes his colours in a preparation of linseed oil, litharge, resin, and balsam of sulphur on a heated iron slab. After cleaning and heating the copper plate he takes some colour on his knife and spreads it on the hot copper plate, pressing it well into the engravings. He then clears away all the surplus colour and cleans the copper plate with a cloth, with the result that the engraved lines remain filled with colour. A sheet of thin paper, damped in soapy water, is now placed on the copper plate and both are put under the press.

The "printers'" press has two rollers, the bottom one of which is fixed and the top one is revolved by means of a handle, there being a heavy iron plank between the two, and on this plank the copper plate is fixed and passed between the rollers. Great pressure is thus exercised, and the saturated paper is forced into close contact with the engraving. The pressure

having been removed the copper plate is placed on the stove, and when warm the paper is carefully lifted at one corner, and as it is peeled off it carries with it an impression of the engraved pattern. The pattern is transferred to the ware by laying the paper, colour side downwards, on to it and rubbing it firmly and evenly.

The printed piece has now to remain for a short time, when it is immersed in water, and the paper floats away, leaving the pattern on the ware.

Although there is no charge for printers' stoves they require careful inspection, being frequently in dangerous proximity to wood benches, etc.

Glaze. Glaze is a composition of flint, borax, Cornwall stone, and china clay, which are fused or "fretted" together.

The "fret" is afterwards ground in water with white lead and Cornwall stone until it assumes a milky appearance, when it is known as "glaze" and is fit for use. This is poured into a tub, and each piece of ware is dipped under the surface that it may become saturated with glaze. It is in these glazing shops where lead-poisoning has such a disastrous effect on the health of the operatives.

The Glost Oven. After dipping, the ware is dried in the hot-house or "mangle," and is then placed in saggers, each piece being separated by a piece of biscuit ware known as a "stilt" or "thimble." As each sagger is filled a wad of fire-clay is placed on the top, so that the sagger forms an air-tight vessel, and prevents the smoke from reaching the ware and spoiling it.

The firing generally takes about 28 hours, and the cooling about 36.

Decorating and Gilding Shops. The ordinary decorations which are put upon English earthenware are lines of colour, and for this purpose a simple wheel known as the "Liner's" wheel is used. A solid wooden head is supported upon a pivot, and the workman placing his plate, or saucer, upon this slowly revolves the head while he holds his fully-charged brush against the edge of the work. A line of colour is drawn out steadily and accurately as the wheel is turned.

When a half-inch or even wider band is wanted, a process known as "Oiling and Dusting" is resorted to. The ware is put on the wheel, and a circle of the required width is described in oil. When the oil has partly dried, the ground colour is "dusted" on to it by means of a piece of cotton wool, and the colour adheres to that part covered with oil. Colour is also "dusted" on to ware by means of the airograph.

Other decorations are put on the ware by flower painters, and there is very little difference between this process and that of painting on paper.

After leaving the painter, the china generally passes to the Gilder. There are two kinds of gold used, "Pure gold" and "Liquid gold." The pure gold is the finest that can be obtained —24 carat—but both the pure and the liquid gold have to be prepared and mixed with oils before being used. When the china is placed in the kiln, the action of the fire drives off the oils and leaves an extremely thin film of brilliant gold on the ware. Fine gold is, of course, also burned on the ware, and the mercury and oils which are mixed with it being evaporated by the fire, a layer of dead gold is left on the china, which layer is afterwards made bright by the labours of the "burnishers."

Enamel Kilns. These are small fireproof chambers, in which the ware is "stilted" for burning in the colours and gold. The heat from the fire-holes surrounding it travels round the kiln until the latter is at white heat.

The ware is ranged on iron racks, as the heat is not too great for the metal, and no saggers are needed; in fact the chamber itself forms a large sagger, and effectually shields the pottery from the flames.

The fire is kept up for some 8 or 10 hours, very slowly at first, but finishing up rapidly, and then every fire mouth is emptied to secure speedy cooling.

At this stage all the goods are generally wanted quickly for orders, and it is important to lose no time in the firing. To facilitate the operation a new kiln has been devised, by which the fire is kept continually burning, and the ware is made to travel through it upon carriages, on the principle adopted in the baking of biscuits and in the "lear" in a glassworks. The tests on these kilns consist of broken pieces of ware, on each of which is placed a smudge of rose colour. This colour, which is prepared from gold,

has the property of altering its tints with every advance in temperature, changing from a brick-red to a pink, and eventually to a dull purple, so that by drawing out one of these fragments and inspecting it when cold the fireman can see to what point his kiln has progressed.

The firing of enamel kilns needs great care, for the margin between right and wrong is very much smaller than is the case with either biscuit or glost ovens. Besides this, the ware in the enamel kilns is of greater value than that in the other kilns, being decorated with more or less elaboration. On the other hand, the fire hazard from an Insurance point of view is not so great, because the fire is much more gentle and more completely under control.

The Packer. After the pieces of ware have been sorted and tested, those ready for delivery are handed to the Packer.

PART III.—FIRE RISK.

China and earthenware works may be divided into two classes —the old and the modern. In the former many defects are to be found with regard to the arrangements of pipe stoves, hot-air flues, and ovens passing through the floors of the warehouses. In point of construction, however, the old factories are really superior, from a fire-risk view, to the modern factory, as they are substantially built, and, although generally communicating throughout, are under several roofings, separated from each other by brick walls. Consequently losses on such are usually confined within a small area.

On the other hand, the modern factory buildings are not only very extensive, with free communications, but they are either under one roof or the roofs intersect. While the fire hazard is reduced by the substitution of steam heat for the potters' stove (fire heat), the drying closets usually run along the centre of the long rooms from one end to the other, and they are constructed of wood, with the steam pipes often in contact. Taken as a whole, however, the modern factory is preferable as a fire risk, as not only does steam take the place of fire stoves, but the packing

houses and straw stores are frequently kept apart from the other buildings, and the ovens stand in a range by themselves.

I believe that the following particulars as to the losses which occurred in the Potteries between January 1890 and August 1900 will be found fairly accurate:—

Of 107 fires (involving a loss of about £40,000), the following were the causes, viz.:—

25 to Packing-houses.
22 to Overheating of flues, ovens, and pipe stoves.
16 Unknown (other than packing-houses).
2 to Steam pipes.
12 Timber too near.
8 to Premature opening of "clammings."
2 to Incendiarism.
20 to origins other than above specified.

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It will be observed that the largest proportion of fires occurred in connection with the packing-houses, and it is somewhat remarkable that, out of 25 fires, 21 occurred between January 1893 and June 1894. The loss on these amounted to about £20,000 during the eighteen months, or 50 per cent. of the total loss for the ten years.

Causes of Fires.

(1) Packing-house fires generally arise from a light thrown down or from a spark from the ovens, but some of them are said to have been caused by spontaneous combustion, the compressed foreign straw being considered by many manufacturers liable to self-ignition.

(2) Hot-air flues are a frequent source of danger in the workshops and drying-rooms, as the brickwork is liable to crack either by the great heat employed or by the subsidence of the ground caused by mining operations. If any wood stillaging be near flues, it becomes completely desiccated, and readily ignites. Iron stillaging is not used for the reason that it would be liable to rust, and prove detrimental to ware in its "green" state.

(3) Ovens.—Fires have been caused by the walls of the ovens being carried through the wood floors of the warehouses without proper precautions having been taken to prevent contact with

woodwork, and fires have also frequently arisen from the "clammings" being prematurely removed, the flames having rushed through the openings made thereby to the outside, and thence to the flooring above.

(4) Stoves.—Ordinary potters' stoves and the piping in connection therewith, as used in the old factories, are frequently in a red-hot condition and quite startling to look upon, but the fact remains that they are seldom the cause of fires.

(5) Spontaneous Combustion.—With reference to the risk to be apprehended from this, I know of a recent loss which took place in a decorating shop, and which arose from the spontaneous combustion of oily gold rags which had been used for "dusting" purposes, and had been placed in a wooden box.

With regard to the moral hazard, experience has shown that in dealing with proposals on china and earthenware manufactories this factor should not escape consideration, and that, as is needful prior to the acceptance of insurances upon other classes of risks, Offices should satisfy themselves as to the *bona fides* and respectability of the proposers.

Until the issue of the first Potteries Tariff in 1895, this class of business was accepted by Offices at as low a rate as 3s. per cent., or even 2s. 6d. per cent. The business upon the non-tariff lines did not prove at all remunerative. Under Sections I. and II. of the existing Tariff, however, with a normal rate for the Potteries of 3s. per cent. and eight or nine extras, and with an initial charge for a packing-house (detached or properly cut off from the other portions of the premises) of 5s. per cent. with three extras, the business has, I believe, proved fairly profitable to the Companies.

FRANK R. PEROWNE.

Norwich Insurance Institute,
February 25th, 1901.

WORSTED MILLS.

When I undertook, in response to our esteemed President's invitation, to contribute a paper on "Worsted Mills," it was my intention to have dealt with the subject solely from a Fire Insurance point of view; but it afterwards occurred to me, that to deal with it from a Manufacturer's standpoint, giving a detailed description of the various processes, and of the machinery used therein, would be more interesting, and I accordingly decided to proceed on those lines. To have treated the subject in such detail in all its branches—that is, in all the various trades which may be classed under the head of "Worsted Mills"—would, however, require a much greater length of time than we have at our disposal this evening; I therefore propose to confine my remarks chiefly to that branch with which we are likely to be brought most into contact in this district—the manufacture of Worsted Coatings.

If one were casually asked when the manufacture of Worsted Coatings was introduced, he would, in all probability, reply "About thirty or forty years ago"; but, on enquiring into the subject, he would find that the introduction of worsted coatings dates from a more remote period. He would have to pursue his enquiry far back into the earliest recorded history, and eventually he would discover, perhaps to his surprise, that the manufacture of worsted coatings was one of the earliest arts practised by man.

The skins of animals, and other primitive forms of clothing worn by our early progenitors, were succeeded by wool garments fashioned from a fabric which was, to all intents and purposes, a "worsted coating." The wool from which it was made, after having been shorn from the sheep, was washed, the fibres straightened by means of a rudely-fashioned comb, and the combed material then drawn into a thread. The threads were afterwards plaited or woven into cloth, which was then dyed or stained in various colours. The same processes, so far as regards their sequence and general principles, are practised to-day in the manufacture of the superb

worsted coatings with which we are all familiar, the only difference being in the method of manipulation by means of the elaborate machinery which is to form the subject of our consideration this evening.

Materials. Before dealing with the machinery, however, it may be desirable to direct our attention to the materials used in the manufacture of worsted yarns, and here let us see that we clearly understand the difference in the meaning of the term "worsted" yarn as distinguished from "woollen." "Woollen" yarns are those prepared by scribbling, carding, condensing, and spinning; "worsted" yarns are those prepared by gilling (with or without a preparatory carding process), combing, drawing, and spinning. The chief object in the manipulation of the materials in the manufacture of woollen yarns is to thoroughly mix and interlace the fibres, both long and short, into a net-like mass; that of worsted yarns, to straighten the longer fibres, lay them parallel to each other, and to reject the shorter ones. Woollen yarns can be, *and are*, made from almost anything of a fibrous character; worsted yarns, on the contrary, are only and can only be made from pure wool, a term which must be understood to include mohair and alpaca. To the Wool-comber or Worsted-spinner, shoddy, mungo, cotton, waste, and the like, are unknown; not so, however, to the worsted-coating *manufacturer*, or weaver; he knows all about them, and I shall have occasion to refer to his knowledge and use of them later. One of the chief functions of the wool-combing machine is to eliminate all short fibres; therefore, if long- and short-fibred materials *were* mixed together in the preparatory processes, the combing machine would separate them; it will thus be seen that for this reason—and there are others—it is impossible to combine wool and mungo, or wool and any other shorter fibre, in a combed or "worsted" yarn.

The wools used include every variety, English, foreign, and colonial, the fibres of which are of sufficient length for combing, from the long coarse Highland wool, such as is used in the manufacture of carpets and the like, to the finest Spanish and American merinos used in the highest class worsted coatings, superfine shirtings, and underwear. The term "merino," however, has now become more comprehensive, and includes all wools sufficiently fine for making into 60's yarn and upwards—that is, yarns of which 60 hanks, each of 560 yards, weigh one pound. Don't suppose, how-

ever, when you are buying "merino" underclothing, that it is necessarily all of fine wool; it may be of something much finer—cotton.

Colonial wool is mostly used in the worsted mills in this district; mohair and alpaca are also largely used for the purposes to which they are specially adapted. Colonial wool is classified by the exporters according to length and quality of fibre, or "staple," into first and second combing, first and second clothing, broken wool, pieces, and locks. It is exported either washed, which means that it was washed before being shorn; or scoured, which implies that it was washed after being shorn, in the same manner as it is washed here; but most frequently it is exported in its natural greasy and more or less soddened state, such as we are accustomed to see it on the backs of sheep here before washing. Alpaca, the wool of Peruvian sheep or llama, and mohair, which is obtained from the Angora goat, are usually exported in the condition in which they are shorn.

Wool-sorting. The first process to which the wool is submitted on being delivered to the Comber is that of sorting, one of great importance in the worsted trade, and involving the careful separation of almost every lock of wool into the special class for which it is best adapted. This, it is needless to say, is a manual process, and one requiring considerable skill and judgment on the part of the sorters.

Before leaving this subject I ought perhaps to make some allusion to the peculiar disease to which the sorter is exposed in the pursuit of his calling, and of which we so frequently hear—viz., "wool-sorters' disease."

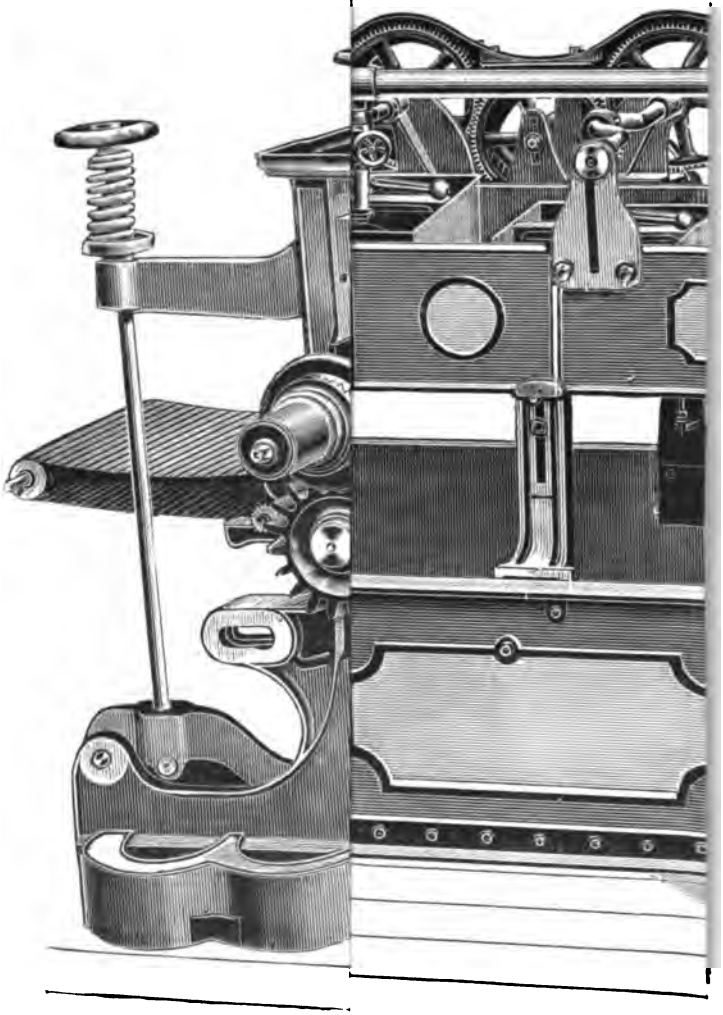
The disease is contracted almost exclusively from mohair, chiefly from that imported from Turkey. Various theories as to its cause have been advanced from time to time, and we are largely indebted to the investigations of Dr. Bell, of Bradford, and of Dr. Rabagliati, a gentleman well known to the members of this Institute, for our knowledge of the nature of the disease, and of the means of its prevention.

Wool-sorters' disease attacks the workers in two different forms—external and internal. The former is often accompanied by the formation of a few vesicles which unite and form a grey scab, the surrounding skin and cellular tissue swelling, and the inflammation spreading until a whole limb or large part of the body is affected;

feverish symptoms set in, the whole constitution is affected, and death frequently results in about a week or ten days' time. In its internal form the disease is generally more rapidly fatal: as a rule, the patient has no pain, only a feeling of excessive and unaccountable weakness, the respiration becomes hurried and difficult, the pulse very quick and small, and the temperature high; soon the pulse becomes very small and the temperature sinks below normal, and the patient dies from exhaustion in from two to four or five days from the commencement of the attack. *Post-mortem* examination reveals the presence, in the blood, of an immense number of minute bacilli, identical in all respects with the "bacillus anthracis," which is the cause of a disease known as "splenic fever," to which all sheep, and the Angora or mohair goat especially, are liable. It is now generally agreed, therefore, that the cause of wool-sorters' disease is due to the presence of these bacilli conveyed in "fallen fleeces," or wool shorn from animals which have died of splenic fever. In the external form of the disease the bacillus is introduced by some wound or abrasion of the skin, and spreads thence until the whole body and blood are affected; and in the internal form the bacillus is inhaled, and is supposed to find its way into the system by means of some minute abrasion in the respiratory passages.

The best preventive would, of course, be to exclude these "fallen fleeces," and to thoroughly wash all suspected wool before sorting, but this is not always practicable. The Board of Trade, however, now require that all mohair be soaked in water before sorting, that the sorters shall have facilities for washing before partaking of food, and that no food be consumed in any room wherein mohair is sorted. The efficacy of these precautions is evident from the fact that no fatal cases have occurred where they have been fully observed.

Wool-washing. The sorted wool is taken to the scouring or washing machine. Various forms of these machines, differing in minor details, but alike in general principle, are in use; the one most generally adopted in this district consists of an iron tank, or rather a series of two, three, and sometimes four tanks, each containing a steam-heated solution of soap, or "hot suds"—other scouring mediums such as are used in woollen mills being unsuitable in worsted mills. The wool is placed on a feed-sheet at one end of the first tank, and by it con-



IPROVED WOOL-WASHING MACHINE

veyed into the hot suds; there it is passed forward by the immersion and slow horizontal movement of a number of forks, and through a pair of squeezing-rollers at the other end, pressure on both rollers being obtained by means of powerful springs. On leaving these rollers the wool is dropped into the hot suds in the next tank, and the process is repeated through as many tanks as there may be, until the wool finally emerges quite clean.

Figure 1 is an improved wool-washing machine which is now being extensively adopted. It consists of two tanks or bowls, one above the other; the hot suds are prepared in the lower tank, and the wool is washed in the upper one. The unwashed wool is placed on the sloping feed-sheet at the end of the machine, and by it conveyed into the upper tank, where, as it enters, it receives a drenching of hot suds pumped from the lower one. There are no forks, the wool being carried along the upper tank to the squeezing-rollers at the delivery end by the inflow of hot suds, assisted by "possers." These "possers" or "shower boxes," which vary in number according to the type of machine (usually six or eight), are metal boxes with perforated bottoms placed at intervals above the upper tank, and each rising and falling by means of a crank device about twenty-two times a minute. As the wool passes under them, it is subjected to the pressure of each in turn, which forces the suds out of the wool and upwards, through the perforations, into the "possers." As the "possers" rise, the suds rush out through the perforated bottoms and again upon the wool. By this process, which, as will be seen, is somewhat analogous to that of cleaning a sponge by alternately squeezing and relaxing it whilst holding it under water, the hot suds are continually passing through the fibres, and perfect cleansing is thereby claimed to be attained without any felting or matting of the wool.

On leaving the last of the "possers," the wool passes through a brass perforated mouthpiece to the squeezing-rollers, then by means of a delivery-sheet to the next machine of the set, a set usually consisting of three or four of these machines.

The suds discharged by the squeezing-rollers are filtered through brass gauze and run into the lower tank, and here another feature of the machine presents itself. The heavier particles, such as sand, dirt, etc., settle to the bottom of the tank, and the scum or "yolk" from the wool floats on the top of the liquid, therefore midway in the tank the liquid is practically clean, and it is at this level that the suds are pumped for washing the wool. By this arrangement the

suds are used over and over again, and a considerable saving of soap is effected.

Wool-drying. If the wool contains any appreciable quantity of "burrs"—a peculiarly prickly seed—it requires to be dried in order that the burrs may be removed. This, as a rule, is done by taking the wool from the washing machine and lightly spreading it on a frame of wire network, where it is dried by a current of heated air being blown through it, or by a current of cold air being drawn through it by means of an exhaust fan; occasionally, but very rarely, it is dried on a machine similar to that used in a woollen mill, in which the wool is conveyed by a feed-sheet into a chamber heated by steam or hot air, where it travels forwards and backwards along iron rollers, and is discharged dry at the other end of the machine. Figure 2 is a section of a machine of this type. The wet wool is fed into the machine at the door C (shown closed), and carried along the lower series of rollers, over steam pipes, to the spiked drum at the other end of the machine; the outlet door B being closed, the drum carries the wool to the upper series of rollers, which carry it back again to the feed end: thus the wool circulates until dry. This machine requires no fan; the hot moist air ascends through the chimneys D D, and fresh air enters under the lower set of steam pipes. When the wool is dried the outlet door B is opened, and the spiked roller throws the wool out upon the floor.

Figure 3 is a section of an improved type of drying machine. In this the wet wool is placed on the inclined face sheet, and deposited upon the top row of a series of steel perforated latticed sheets; the top row carries the wool through the machine and drops it upon the row beneath, and so on; meanwhile hot-air is blown through the perforations in the rows of sheets, thus the wool is carried to and fro until delivered dry from the bottom row.

Burring. Many devices have been introduced for detaching burrs from long combing-wool. The machine which answers so admirably in the shorter clothing-wool in woollen mills is unsuitable here, and chemical extraction has (for worsted purposes) a detrimental effect on the fibres. Perhaps the best machine at present in use is the patent burr-crushing machine supplied by Taylor, Wordsworth & Co., of Leeds. In this machine the wool is passed between two

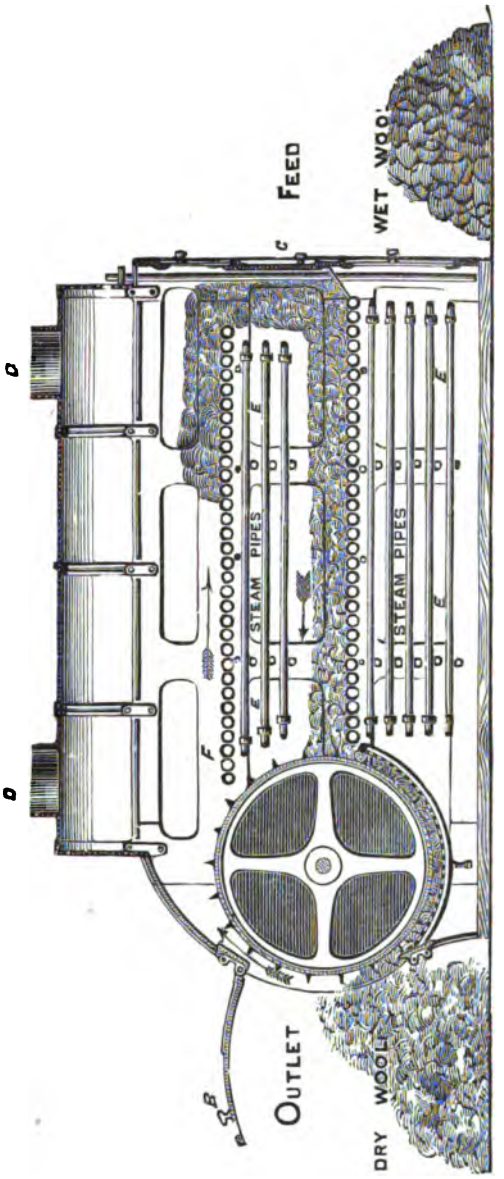


Figure 2. Wool-Drying Machine. (Wm. Whiteley & Sons, Ltd., Huddersfield.)

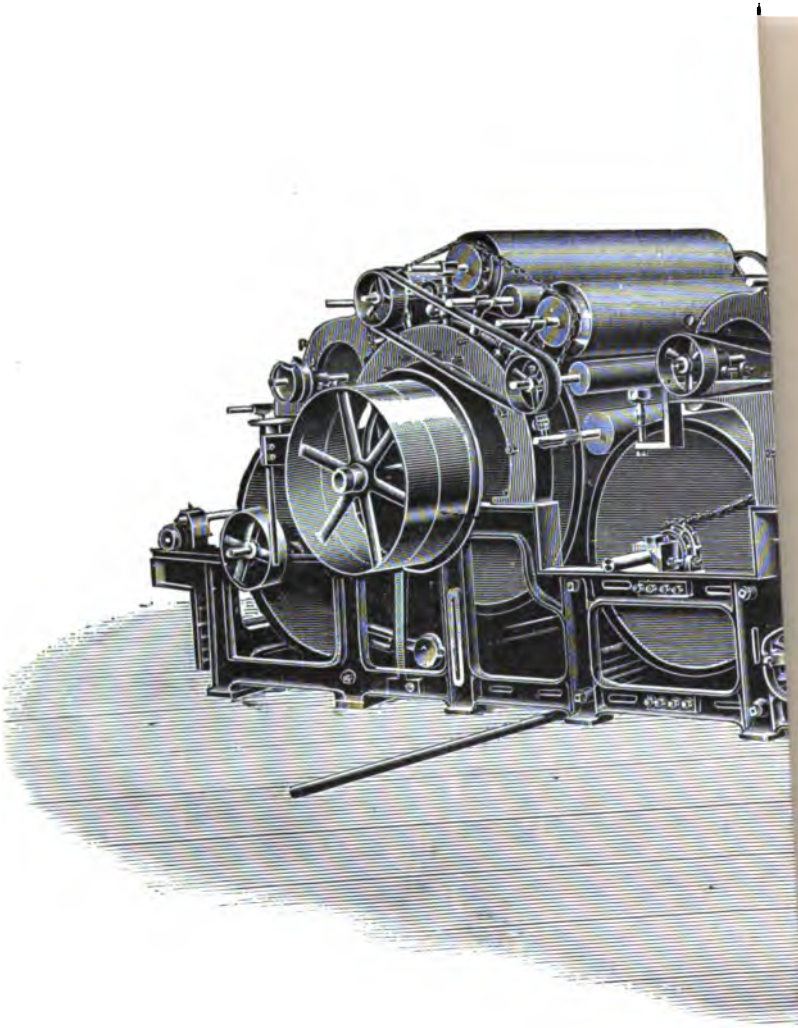


Figure 4.

brass rollers, then through two rollers covered with wire card-clothing and having a slight "draft" (that is, travelling a little more quickly than the first pair of rollers, thereby drawing the wool to some extent), then through a pair of rollers 10in. in diameter running very quickly, one quicker than the other, and in close contact, where the burrs are crushed into dust, which drops from the wool in the succeeding processes.

Carding.

In fine wools, which do not require burring, the wool is taken from the washing machine in its damp condition, sometimes receiving a very slight sprinkling of oil (not more than 1-50th the quantity it would receive in a woollen mill), direct to the carder—a machine very often similar, in nearly all respects, to a scribbler in a woollen mill, but more frequently a machine specially constructed for carding wools for combing (Figure 4). The wool is placed in a hopper feed (not shown in the illustration), where it is automatically weighed, and evenly spread on the feed-sheet, which slowly conveys it to a pair of feed rollers, covered with brass, and studded with porcupine steel pins. On emerging from the feed rollers it is seized by the first of four cylinders, called "lickers-in." The first licker-in is covered with "Garnet" wire, such as we see on a Garnet waste-pulling machine, the other three being covered with ordinary card-clothing. Between the lickers-in are four smaller cylinders, called "dividers," two above and two below, also covered with card-clothing, which transmit the wool from one licker-in to another, whilst slightly carding it at the same time; the upper dividers are operated on by "beaters" (hollow iron tubes fitted with steel blades) which, in revolving, beat out burrs, seeds, and other foreign matter from the wool. The last of the dividers conveys the wool to the first of the two main cylinders or "swifts," which, as well as the rollers above them, are covered with card-clothing, and where the wool is manipulated in precisely the same manner as in a woollen scribbler. The three larger rollers, above each of the two swifts, operated by chains, are called "workers." The workers revolve very slowly, and in revolving each receives a continuous deposit of wool from the swift; the wool is carded in the process, by the teeth of the card-clothing in the swift and workers being opposed to each other—that is, turned in opposite directions at the point where the wool is deposited; the smaller rollers between the workers, called "strippers," strip the carded wool off the worker and return it to the swift.

igure 4.

The "doffer"—the cylinder between the two swifts—receives the wool from the first swift; another stripper, called an "angle stripper," takes the wool off the doffer and delivers it to the second swift, where the carding process is repeated. The largest of the rollers over the swift, just above the junction of the swift and the doffer, is called a "fancy"; the fancy revolves very quickly, and its function is to raise or brush the wool up to the surface of the card-clothing on the swift, so as to facilitate its delivery to the doffer. The swift revolves in the direction of the delivery end of the machine; the doffers, fancies, workers, and strippers revolve in the opposite direction. From the last doffer the wool is stripped by a crank—a plate with a comb, or saw-like edge—having a rapid vertical or chopping movement, from which it is conducted through a small revolving funnel, which imparts a slight twist, and is then coiled in rope-like form, called "sliver," into a can, ready for the next process.

Wool-shaking. Before dealing with the next process we will go back to the wool-washing machine: you will remember that fine wools were taken direct from the washing machine to the carder. In long coarse wools, however, such is not always the case; very coarse matted wools may require, after first being first washed and dried as before described, to be put through a "willey" or "Fearnought" (Figure 5), a machine similar in all respects to that of the same name used in a woollen mill; the rollers are armed or studded with formidable iron tenter-hook or cock-heel teeth, which loosen the matted fibres and prepare the material for the more pacific subsequent operations. All long coarse wools, either with or without being subjected to manipulation in the Fearnought, are then taken, not to a carder, but to a series or set of "Preparers."

Preparing. The function of the Preparers is to straighten and separate the fibres of the wool preparatory to combing. A Preparer consists of simply two pairs of fluted steel rollers, with a set of "gills" or "fallers" intervening; the wool passes through the first pair of rollers, which are called "back" rollers, then through the fallers, then through the second pair of rollers, which are called the "front" rollers, when it is delivered on the floor or in a basket. The "gills" or "fallers" consist of a number of steel bars studded with upright steel pins—

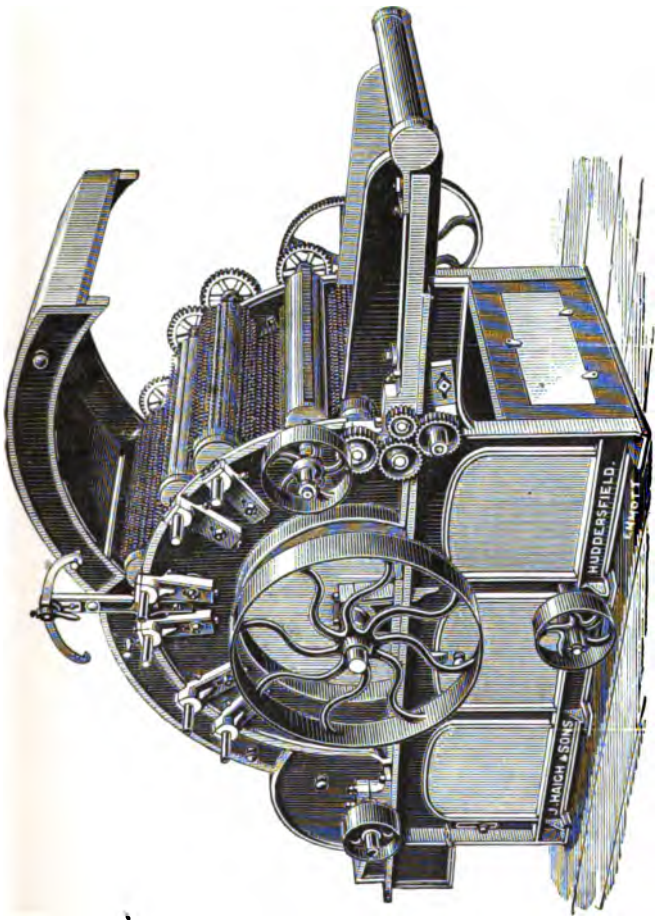


Figure 5. TENTER-HOOK WILLEY, OR FEARNOUGHT.
(John Haigh & Sons, Huddersfield.)

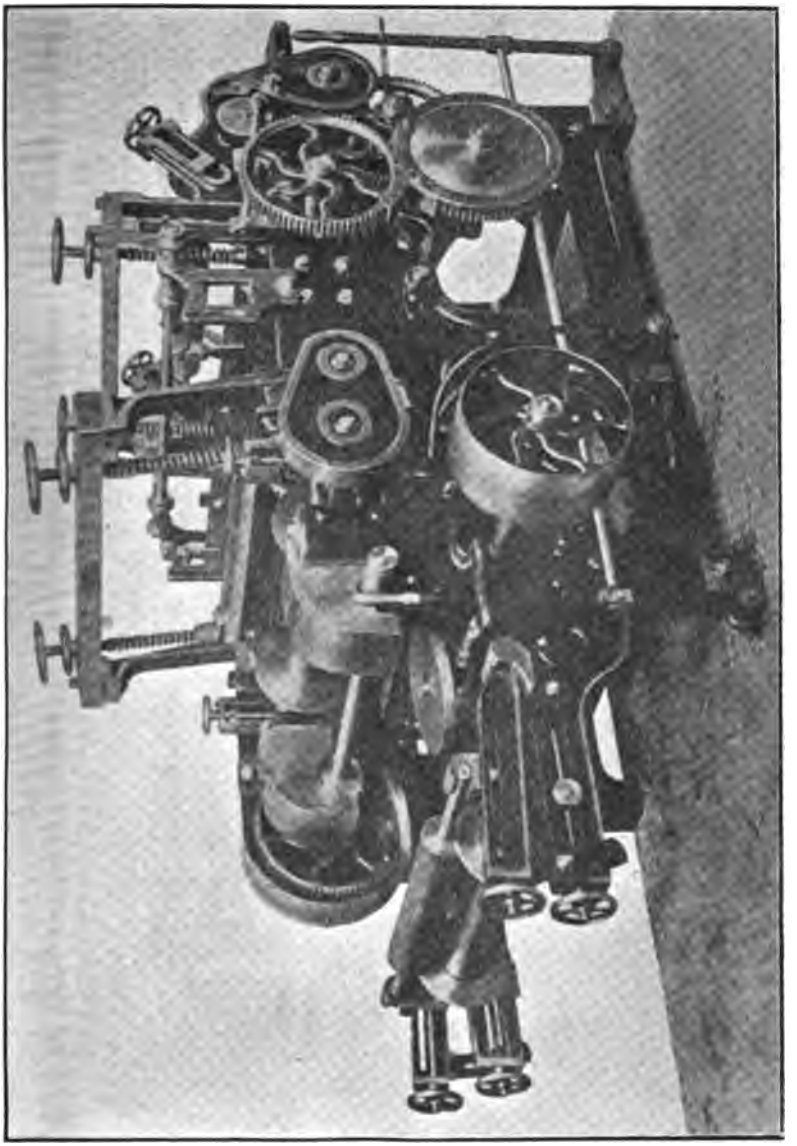
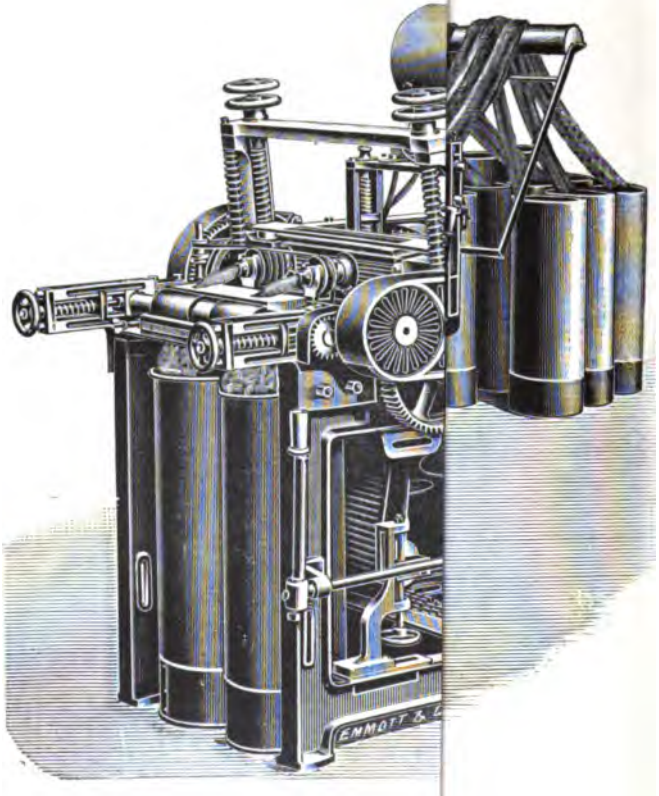


Figure 6. Double Screw Preparer. (Prince Smith & Son, Keighley.)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hackle pins; the bars are placed parallel to each other and to the rollers—that is, at right angles to the direction in which the wool travels—they also, operated by a screw or worm, travel along with the wool, but the relative speed of the fallers and rollers may be varied so as to produce what is called a "draft," either between the back rollers and the fallers, or between the fallers and the front rollers. In the former case the forward motion of the fallers is quicker than the rate of delivery of the back rollers, the operation being precisely the same as if a comb were drawn through the hair of the head, and the head moved in the same direction as the comb at the same time; in the latter case the front or delivery rollers travel more quickly than the fallers, as if, to use a similar illustration, the hair were drawn through the comb. A series of Preparers usually consists of five or six of these machines, alike in their operations, the difference being that the pins in the fallers become gradually finer, from about two per inch in the first, to seven per inch in the last, and that the first two machines usually deliver the prepared material in a sheet, and the last three or four deliver it in "sliver," or rope, into a can. Figure 6 is a double-screw preparer, so called because it contains two sets of gills or fallers, one behind the other.

We have now got the fine wools, *via* the Carder, and the long coarse wools, *via* the Preparer, into a sliver or rope; and as they are henceforth to be subjected to identical processes, no further distinction need now be made between them.

Back-washing. The cans of sliver from the Carder (or from the Preparer, as the case may be) are now taken to the back-washing machine (Figure 7), in which the sliver from ten to thirty cans is conveyed simultaneously through a pair of guide rollers into an iron tank containing hot suds, as in wool-washing; then through a pair of squeezing rollers, through a second tank of hot suds, again through a pair of squeezing rollers, then partially dried by being passed over steam-heated cylinders, then through a set of gills, as in the Preparer, but finer, and with more "draft," varying according to the nature of the wool, where the mass of sliver is divided into two equal parts, each passing through a small revolving funnel into cans, or wound on balls. As it leaves the last of the heated cylinders, the sliver receives a small quantity of oil from the small cistern above, usually about 2½ per cent., or one-tenth of the quantity that would be put on a like

weight of wool in a woollen mill. Gallipoli or olive oil is the kind almost exclusively used; composition oils are rarely used, being altogether unsuitable for worsted purposes.

Gilling. After leaving the back-washing machine, the sliver is, as a rule, again put through two gill-boxes, the first of which is identical with the last of the preparer-boxes before mentioned (see Figure 6), and the second only differs in the gills—that is, the pins in the fallers—which are again finer and closer set. The last box either delivers the sliver into a can or winds it on one or two balls, ready for the most important and most interesting of worsted processes—the wool-combing machine.

Wool-combing. Formerly, and, in fact, up to within almost recent years, wool for worsted yarns was all combed by hand. A comb, in appearance very much like a rake, with a short handle and two or three rows of long teeth, was fixed on a post, teeth upwards. The comber laid a small quantity of wool on these teeth, and with a similar comb in his hand he lashed the wool from the teeth of the fixed comb; the combs were then reversed, and the process repeated until all the short fibres, or "noil," had been combed out of the longer ones, and the latter laid straight and smooth.

A record of the early struggles of inventors in their long and patient endeavours to discover a method of combing by machinery; of the numerous inventions which have been adopted from time to time, only to be discarded, and the enormous amount of litigation which arose in connection with them, would in itself form the subject of a very long, but no doubt very interesting, paper; we need, however, only consider the inventions that have survived, and in their improved form are at present in use.

Figure 8 is the "Lister" or "Nip" comb, and the principle of its operation is as follows:—The sliver from twenty to thirty cans is passed simultaneously through a screw gill-box, similar to those already described, but having no front or delivery rollers. A dabbing brush, H, having an up and down motion worked by an eccentric device, presses or dabs the wool into the pins of the fallers F F as they carry it forward. A wide jaw, A, called the "nip," which gives the machine its name, actuated by a rod from the front wheel W, then comes forward close to the fallers, seizes the

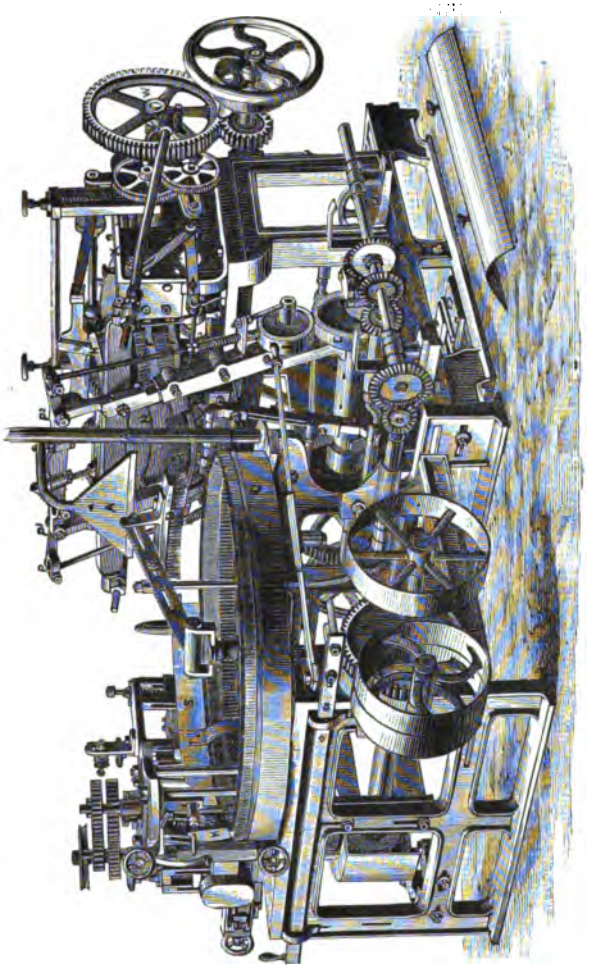


Figure 8. Lister or "Nip" Comb.

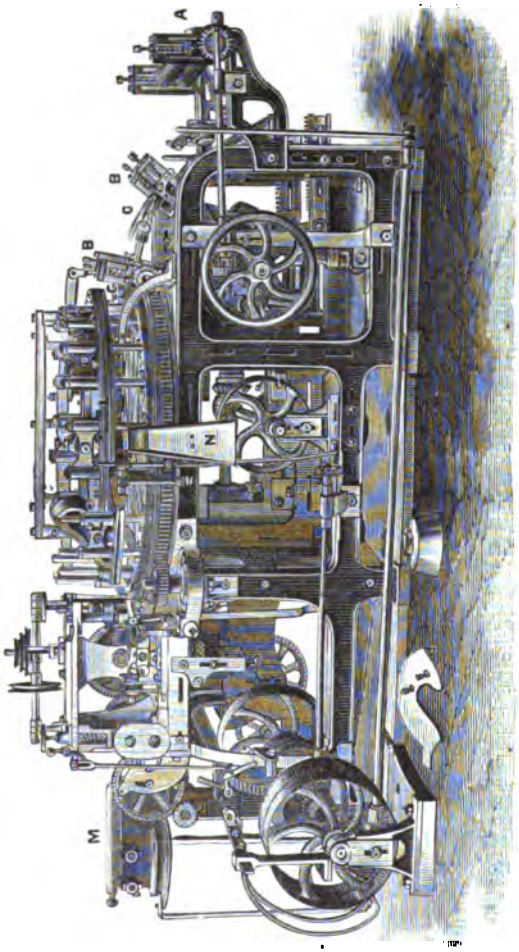


Figure 9. HOLDEN OR "SQUARE MOTION" COMB.

wool which is projecting from them, and, in retiring, draws all the fibres through the pins of the fallers. The "nip" then holds, suspended from its jaws, a fringe of wool which has been effectually combed by having been drawn through all the pins of the fallers. The "nip" then opens and deposits its charge of wool upon a carrying comb B, which, in turn, places it on the pins of the circle C, and in such a manner that the combed fringe overhangs; the uncombed portion, that which was in the jaws of the "nip," being laid on the pins of the circle, into which it is dabbed by another dabbing brush D. The circle slowly revolves, receiving meanwhile in the manner described a continuous deposit of layers of wool; presently a pair of drawing-off rollers seize the overhanging and already combed portion of the fibres, and in drawing it off draws it through the pins of the circle, thus effectually combing the other portion; the short fibres, or noil, remain in the pins until, as the circle travels further round, they are raised and removed by a number of inclined planes, or knives, which dip between the teeth.

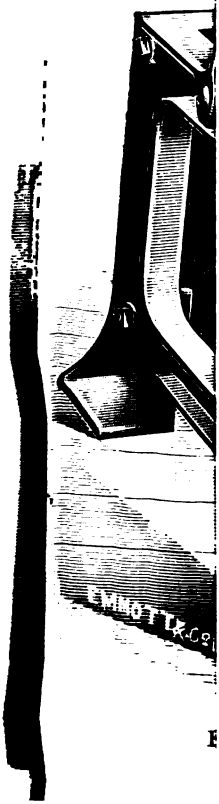
This combing machine, though not now perhaps extensively used, is still considered by many to be the best for combing English and other long wools.

Figure 9 is the Holden or "square-motion" comb. In this the slivers are gathered into two thick coils, which pass through a pair of conducting rollers A, to two pairs of feed rollers B B, one thick coil to each. These two pairs of feed rollers, actuated by an eccentric device, alternately move forwards and backwards; in their forward movement they approach the outer rim of the main circle, and deposit a layer of wool on the pins; the layers increase by repeated deposits, and as the circle revolves they, or rather the overhanging fringe, encounter a set of fallers, similar to the fallers in the gill-boxes before described, but larger, curved to fit the convexity of the circle, and having the pins very much finer set. The fallers work rapidly, and as each rises it receives on its pins the fringe of wool projecting from the main circle, and thus, in receding, combs it most effectually, the wool in the circle being firmly held by pressure blades which, at this point, press between the rows of pins. The fallers retain the short fibres, or noil, which is afterwards brushed off them and allowed to fall into a can. Proceeding onwards, the wool in the main circle next encounters the main feature of the machine, the intersecting comb, whose special purpose is to comb that part of the wool which was held by the pressure blades in the main circle whilst the fallers were operating.

This is effected by the intersecting comb (which is in sections) having its pins point downwards, and slightly overlapping those of the main circle; an ingenious device lifts the wool from the pins of the main circle into those of the intersector, it is then seized by the drawing-off rollers, and perfectly combed by being drawn off through the pins of both main circle and intersector.

As the Lister or "nip" comb is considered to be the best machine for combing long wools, so is the Holden or "square-motion" comb believed to be the best for combing very short wools, and it is largely used for that purpose. But the machine most generally in use, as the best adapted for all-round work, and with which you will, no doubt, be the most familiar, is the Noble's or "circular" comb (Figure 10). Before describing this we will resume the sequence of processes from the last of the preparing gill-boxes. It will be remembered that after back-washing and gilling we left the sliver either coiled in cans or wound on balls. To adapt it to the arrangement of the Noble's comb, the slivers are taken to a machine called a "punch" or lapping-box (Figure 11), the function of which is to wind four slivers together on one ball. Eighteen of these balls are placed on rollers on the Noble's comb, below and surrounding the inevitable "circle" with its rows of pins. The slivers, seventy-two in all, pass through guides, then through conductor-boxes, which are made of brass or gun-metal so as to avoid rust, the slivers being slightly damp from the back-washing machine. Inside the large circle, which rests on a steam chest to keep the pins clean and bright, are two smaller circles, also studded with pins. All three circles revolve in the same plane and in the same direction, and are so arranged that the outer rims of the small circles all but touch the inner rim of the large one. The rollers, with the sliver balls on them, the guides and conductor-boxes, all travel round along with the large circle. During their journey round, the conductor-boxes, with the wool in them, are slightly lifted by riding over an inclined plane; in descending, they grip and drag a small portion of sliver from the balls below, and lay the portion of sliver which now projects from them upon the pins of the large outer and of one of the small inner circles simultaneously, by depositing it at the tangent point, or the point where the rims of the two circles are nearest each other; at the same instant a dabbing brush, which gives about 400 dabs a minute, descends, and forces the wool to the bottom of the pins in both circles. Now, in the revolution of both circles, the rim of the smaller circle naturally recedes from that of the larger

Worsted Mill



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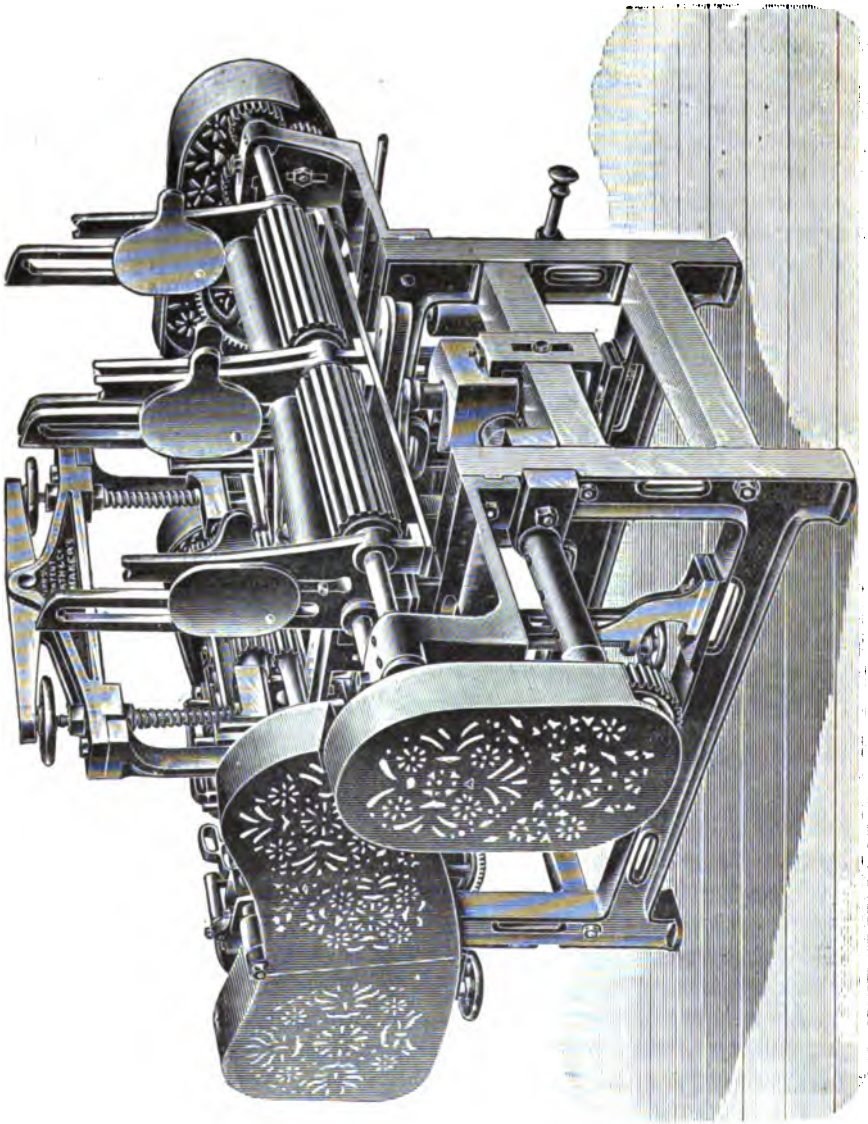


Figure 12. Double-head Second Finisher Box. (Taylor, Wordsworth & Co., Leeds.)

one, and it is in this movement that the combing is done. It will be obvious that in gradually separating, neither circle can retain the whole of the wool which has been dabbed into it: the consequence is, therefore, that the large circle draws a portion out of and through the pins of the small circle, and, in like manner, the small circle draws a portion out of and through the pins of the large circle; these portions, which project or hang in a fringe from the inner face of the large circle, and from the outer face of the small circle, respectively, have been effectually combed by having been drawn through the pins of one or the other.

Continuing the journey, each circle encounters a pair of drawing-off rollers, which seize the projecting combed fringe of wool (the fringe having been turned in the required direction by the motion of the star-like wheel called a "stroker"), and, in drawing the wool off, the other ends of the fibres retained in each circle are effectually combed by being drawn off through the pins. Meanwhile the like operation has been going on, in duplicate, with the second of the smaller circles on the other side of the machine. The combed slivers from all the circles are conveyed to the centre of the machine, and there united into one sliver, passed through a small revolving funnel, and coiled in a can. The short fibres, or noil, which are collected by the smaller circles, are raised to the tops of the pins by means of knives which dip between them, and cast into a box underneath the machine.

The combed sliver is then put through one or two finishing gill-boxes, alike in all details to the gill-boxes previously described, except that the pins are again finer and closer set. Figure 12 is a "double-head" second finisher box. This must not be confounded with a "double-screw" gill-box before mentioned (see Figure 6). A double-screw gill-box (Figure 6) has two sets of gills or fallers, one behind the other, and operating on the same sliver; a double-head gill-box (Figure 12) has also two sets of gills, but they are placed side by side, and operate on two separate slivers—it is really two single boxes in one.

From the last of these finisher boxes the combed sliver is delivered in the form of a ball; this ball is known as a worsted or combed "top"—all short fibres and foreign matter removed, and the long fibre scleaned, combed, and straightened, ready for the Spinner. With this final gilling process the business of a Wool-comber ends.

If it is intended to dye the top, it is usually formed into a hank, and dyed by the customary process of boiling with dye-wares in a

tank or cistern. After dyeing, it is necessary that it should be re-combed; therefore, on returning from the dyers, it is wound from the hanks into balls again for the combing machine. Sometimes several colours of "top" are mixed together; this is done in a "multiple-head" gill-box. Figure 13, which is a 6-head can gill-box, consists of practically six gill-boxes side by side. Half-a-dozen or more slivers of different colours may be put through each of the six heads, and the whole are collected and blended into one sliver, which passes through the three pairs of small rollers, and is delivered into a can. The dyed (or blended) sliver is then again put through the combing machine and the finishing gill-boxes, when, like the white "top" before mentioned, it is ready for the Worsted Spinner.

Drawing. The next process to which the combed sliver or top is subjected is the "drawing," which forms a part of the Worsted Spinner's function. The object of drawing is merely to reduce the thickness of a sliver, or of several slivers, and the method is simplicity itself—by passing the sliver or slivers through two pairs of rollers, of which the second pair revolve quicker than the first. To ensure an even thread, however, it is necessary that the sliver should be reduced in thickness gradually: it is therefore passed through a series of several drawing-boxes.

The following course of drawing may be taken as a representative series, although considerable modifications are adopted by Spinners, according to special requirements or individual preference.

The top, or rather twelve tops, are placed on a revolving creel, and, from it, are fed into the first, or double-head can gill-box, similar in operation and appearance to the gill-boxes before described, but with two sets of finer and closer set pins, and more "draft". From this box the sliver is delivered into a double can. Twelve slivers from these cans are then taken to the second, or 2-spindle gill-box (Figure 14), six slivers to each spindle; this is similar to the first, but the gills are again finer; and the gilled and drawn sliver, as delivered, is wound upon bobbins by the action of a flyer, which also imparts a slight twist. The bobbin is loose on the spindle, and the flyer, in revolving, drags it round at its own speed, less the speed or rate of delivery of the sliver; this motion winds the sliver on the bobbin, whilst imparting a twist at the same time. Here the gilling processes end; that is to say, the succeeding machines have no gills or fallers, but the drawing begins to increase,

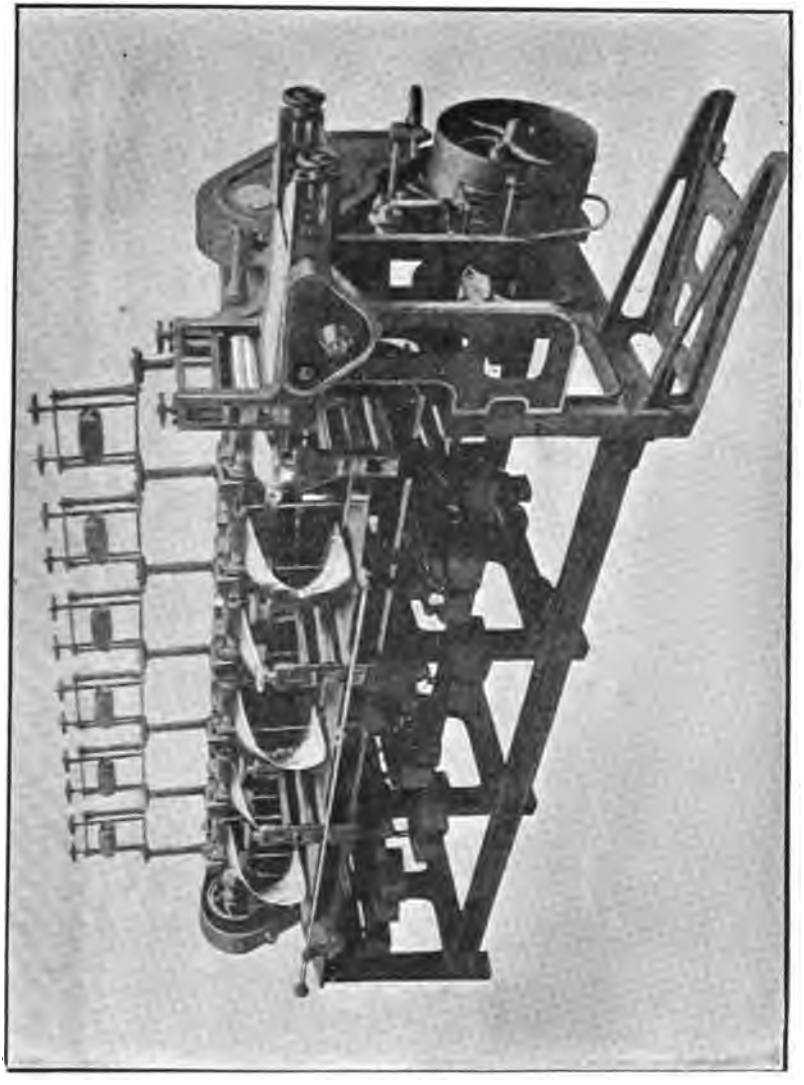


Figure 13. 6-Head Can Gill-Box. (Prince Smith & Son, Keighley.)

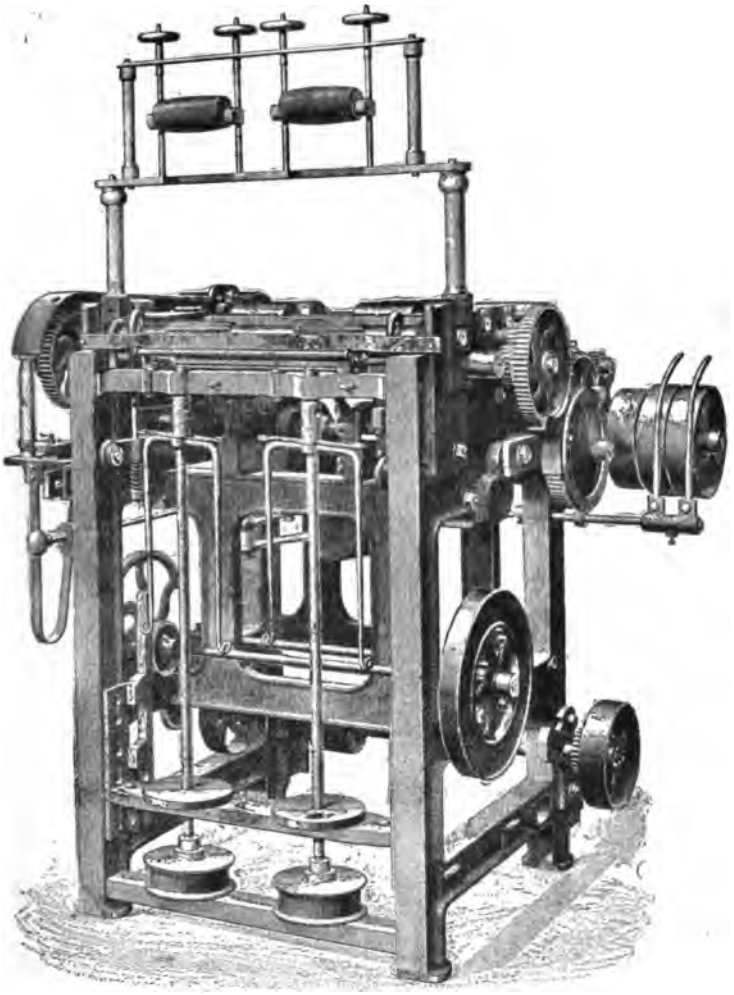


Figure 14. 2-Spindle Gill-Box. (Prince Smith & Son, Keighley).

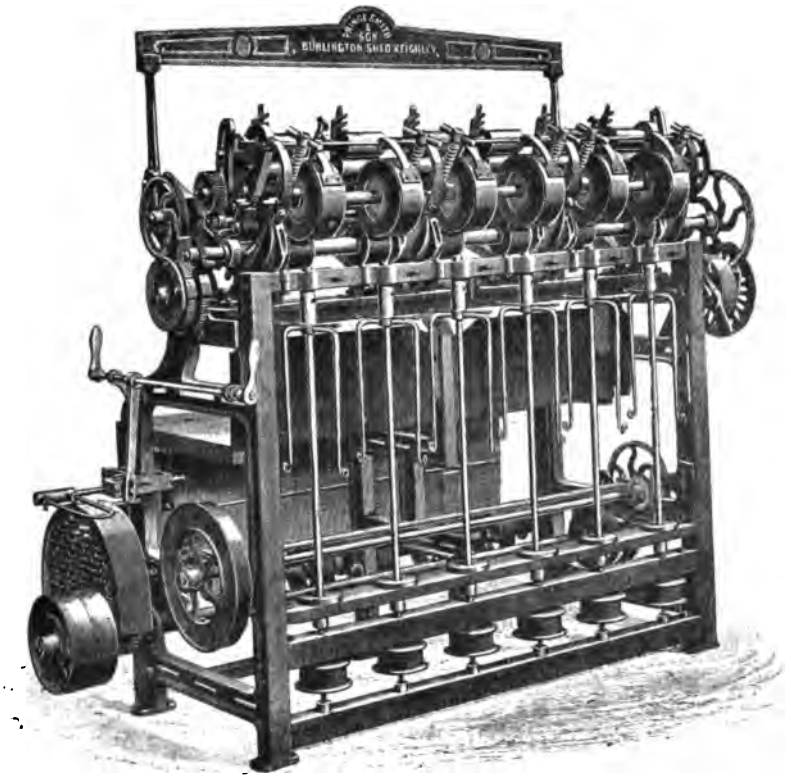


Figure 15. 6 SPINDLE WEIGH-BOX.

(Prince Smith & Son, Keighley.)

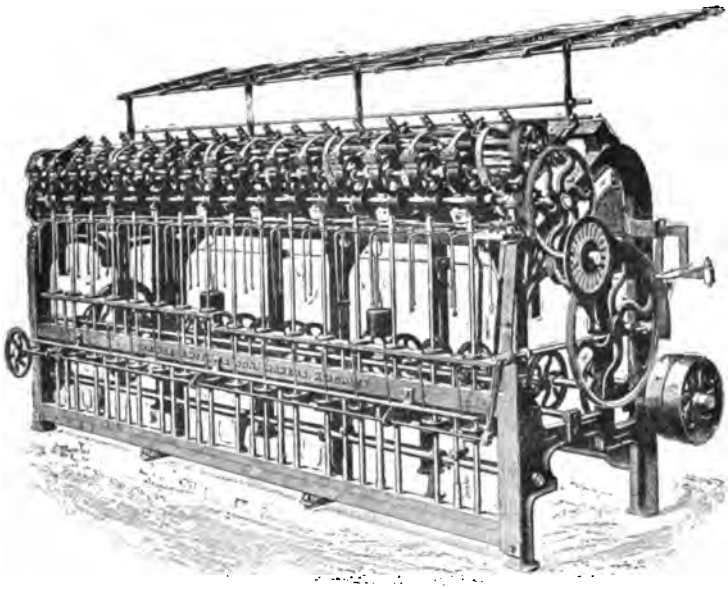


Figure 16. 16 Spindle Second Finisher.

(Prince Smith & Son, Keighley.)

and the speed to be accelerated. The spindles in Figure 14 revolve at the rate of about 100 per minute.

Twenty-four bobbins from the second box are placed on a creel attached to the third, or 4-spindle drawing-box, six bobbins to each spindle, in which the sliver, now called "slubbing," is simply drawn smaller. As its name implies, it winds the "slubbing" on four bobbins. Its appearance is much the same as Figure 14, except that it has four spindles instead of two, and is without gills or fallers; the speed of the spindles is about 180 revolutions per minute.

Thirty of these bobbins are then taken to the fourth, or 6-spindle "weigh-box" (Figure 15), five bobbins to each spindle; a drawing-box much the same as the foregoing, but with six spindles, revolving at the rate of about 200 per minute, and having a device for automatically stopping the machine when the six bobbins have each received a given weight of "slubbing," hence its name.

Thirty-two of these bobbins are then taken to the fifth or 8-spindle drawing-box, four to each spindle (a machine similar in appearance to Figure 15, but with eight spindles instead of six), when the drawing process is continued. The speed of the spindles is about 220 per minute.

Twenty-four bobbins from the fifth are taken to the sixth or 8-spindle "finisher"; precisely the same as the preceding, except that it is fed with three bobbins per spindle instead of four.

Thirty-two bobbins from the sixth are taken to the seventh, or 16-spindle second finisher (Figure 16), two bobbins per spindle. Here the speed begins to accelerate rapidly, the revolutions being about 400 per minute.

Thirty-two bobbins from the seventh are taken to the eighth, or 16-spindle "reducer" (a machine similar in appearance to Figure 16), two bobbins per spindle; the spindles revolving at the rate of about 1000 per minute. And finally, forty-eight bobbins from the eighth are taken to the ninth, or 24-spindle "dandy rover," a machine somewhat resembling Figure 16, which, as its name implies, delivers the slubbing, or, as it is now called, "roving," on twenty-four bobbins, when the process of drawing is complete. The speed of the spindles in the dandy rover is about 1300 per minute.

The foregoing system is known as "open" drawing—in it the bobbin is dragged round by the flyer hauling or pulling at the slubbing. As the bobbin increases in bulk, and consequently in

weight, this action tends to "twit" or stretch the slubbing, thereby producing uneven yarn; this defect is most pronounced in wools of short staple. Numerous attempts have been made to remedy the defect, and success has been attained by the introduction of "cone" drawing-boxes (Figure 17). In them, the bobbins, instead of being left to be hauled round by the flyer, are driven by a belt; but as the bulk or diameter of the bobbin is continually increasing by the accession of fresh slubbing, whilst the rate at which the slubbing is delivered remains the same, the speed of the bobbin has, of necessity, to be reduced; this result is attained by driving them with cones. The apex of the driving cone and that of the driven

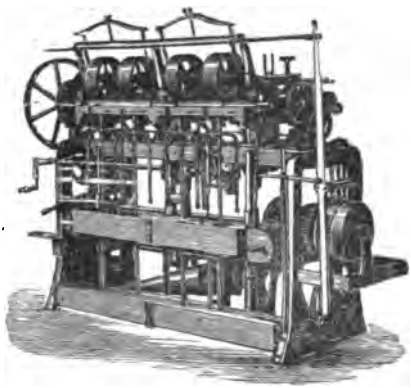


Figure 17. Cone Drawing Box.

(Taylor, Wordsworth & Co., Leeds.)

cone point in opposite directions. At first the bobbins are driven with the belt running from the widest part of the driving cone to the narrowest part of the driven one; this, of course, gives the highest speed. As the bobbin gradually increases in bulk, it therefores requires to be gradually reduced in speed; this is attained by the belt being gradually moved, by a mechanical device, along the cones, until, eventually, when the bobbin is full, it is running at its slowest speed by the belt having been moved to the narrowest part of the driving cone and to the widest part of the driven one, thus all drag on the slubbing by the flyer is avoided, and the slubbing or roving is evenly wound.

In addition to "open" and "cone" drawing, which differ only

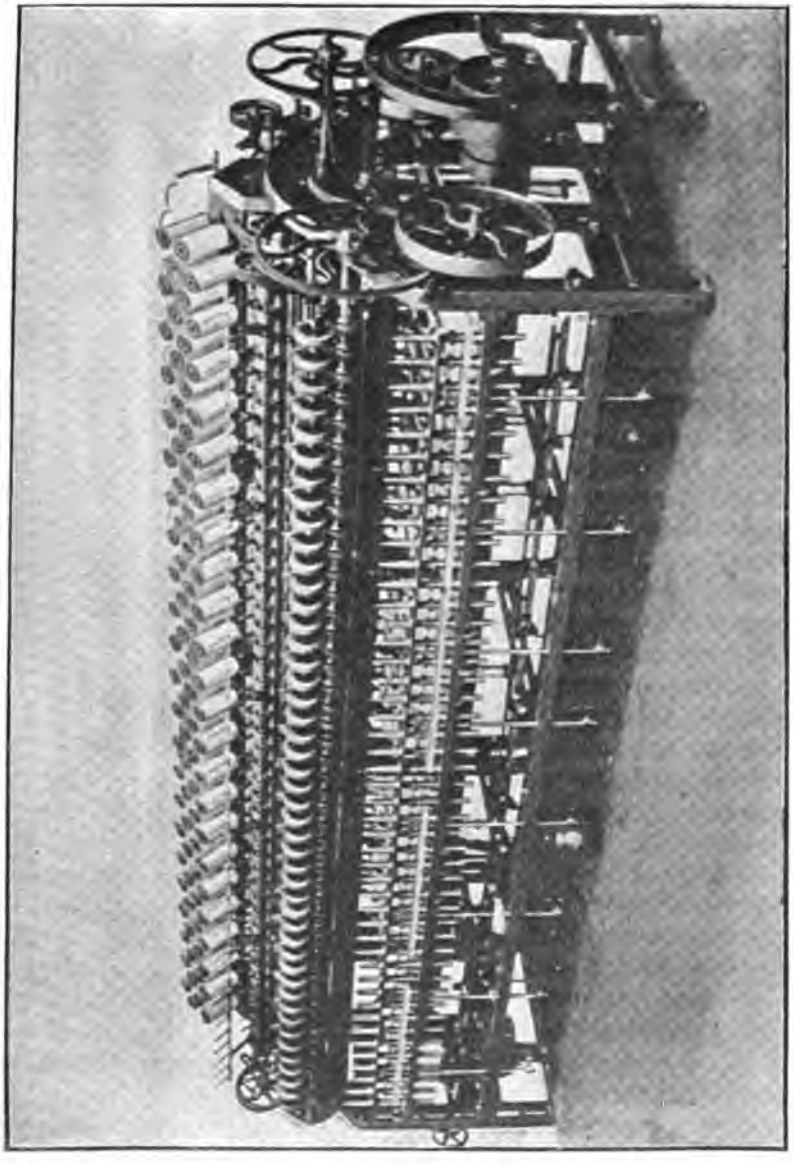


Figure 18. "Ring" Spinning Frame. (Prince Smith & Son, Keighley.)

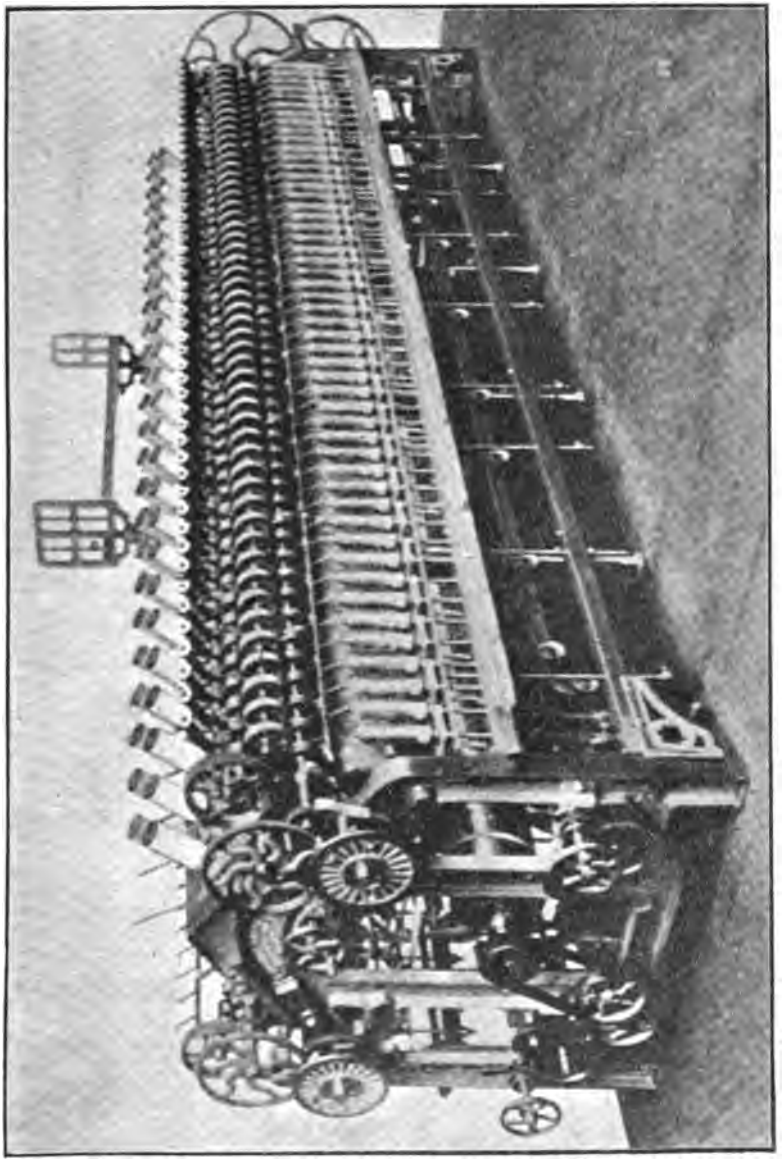


Figure 19.—"Cap" Spinning Frame. (Prince Smith & Son, Keighley.)

in the manner in which the bobbins are driven, there is the system known as "French" drawing. In French drawing-boxes, the sliver, or slubbing, instead of being drawn through gills, is drawn over revolving "porcupine" rollers—rollers studded with steel pins—and instead of being twisted and wound on to vertical bobbins by means of flyers, it has no twist whatever imparted to it, but is rubbed into a thread by leather rubbers similar to those on a condenser in a woollen mill, and wound on bobbins placed horizontally; but as the system does not find much favour in England, we need not consider it in further detail.

Spinning. On leaving the drawing-boxes, the next process is that of spinning, in which the slubbing or roving is finally drawn into a thread, then twisted and wound on small bobbins. There are three systems of spinning—"flyer," "ring," and "cap." Figure 18 is the "ring," and Figure 19 is the "cap" system. The method of drawing is common to all. Bobbins of roving are placed on pegs at the top of the frame, one per spindle; the roving passes through a pair of back rollers, then through three small carrier rollers, and finally through a pair of front rollers, where it is drawn to any required extent by means of the relative speed of the back and front rollers. It is in the method of imparting twist to the thread, and in that of winding it on the bobbin, where the systems differ.

In the "flyer" system the action is precisely the same as in the drawing-boxes, the "flyer" twisting and winding the thread whilst hauling the bobbin round. "Flyer" frames are mostly used for long wools, as they do not admit of being driven at a high speed, 2400 revolutions of the spindle per minute being about the maximum.

In "ring" frames (Figures 18) the bobbin is driven by a "whorl" or disc attached to the spindle, having projections which fit into a groove cut in the head of the bobbin. As the spindles revolve at about 4000 revolutions per minute, thereby considerably increasing the output of yarn, these frames are rapidly superseding "flyer" frames except in long coarse wool.

In the "cap" frames (Figure 19) the spindle is stationary, or "dead" as it is called; on it, however, there is a small brass tube driven by a tape: the bobbin is slipped over the brass tube and driven by a "whorl" as in the "ring" frame. The tube and bobbin are covered by a stationary "cap," usually of steel, attached to the

top of the spindle; the tube and bobbin revolve at the enormous speed of 7000 revolutions per minute. From the advantages thus afforded, it would appear that "cap" frames should be universally adopted. Unfortunately, however, they can only be used for spinning fine wools, as the high speed at which they run would dash a coarse thread to pieces, or at all events make it very wild and "starey."

If it be intended to twist two or more threads together, the operation is performed on a Twisting frame, similar in all respects to a Spinning frame, except that it is without draft, therefore there are neither front nor carrier rollers. The threads to be twisted together are passed through one pair of rollers only, and direct to the bobbin on the spindle, receiving the required twist by "flyer," "ring," or "cap" system, as the case may be. The latest form is the "trap" twister. In this the thread, instead of going through a pair of rollers, is carried round a leather-covered vertical drum, and then through an eye in a lightly-balanced lever; should the thread break, the lever falls, and by connecting mechanism stops the vertical drum, thus preventing the thread from running to waste. Hence the name "trap" twister.

It will, of course, be understood that, in twisting, threads of different colours and of different materials, silk, cotton, etc., may be combined as desired.

If the yarn be required for weft it is wound on small bobbins or "spools," to fit the weaver's shuttle. Figure 20 is a Yarn winding machine, which, as shewn, winds from hank, bobbin, or cop below, to the spools above. The spools are driven by being each placed, "nose" downwards, amid three revolving inverted cones, and the yarn wound on them in a tapering spiral so that it may be drawn off the end of the spool when placed in position in the weaver's shuttle.

If the Yarn is intended for warp it is similarly wound on larger bobbins and taken to the Warping mill (Figure 21); the bobbins are placed in the creel, the threads drawn off simultaneously, and so conveyed as to form a thick coil, or web, which is wound round the large reel or swift, to be afterwards transferred to the power-loom beam. "Single" warps, that is warps composed of single threads as distinguished from those composed of two-fold yarn, and occasionally two-fold warps which are to be subjected to much friction in the looms, require to be sized; in which case the web is sometimes sized by simple mmersion in a trough containing size—

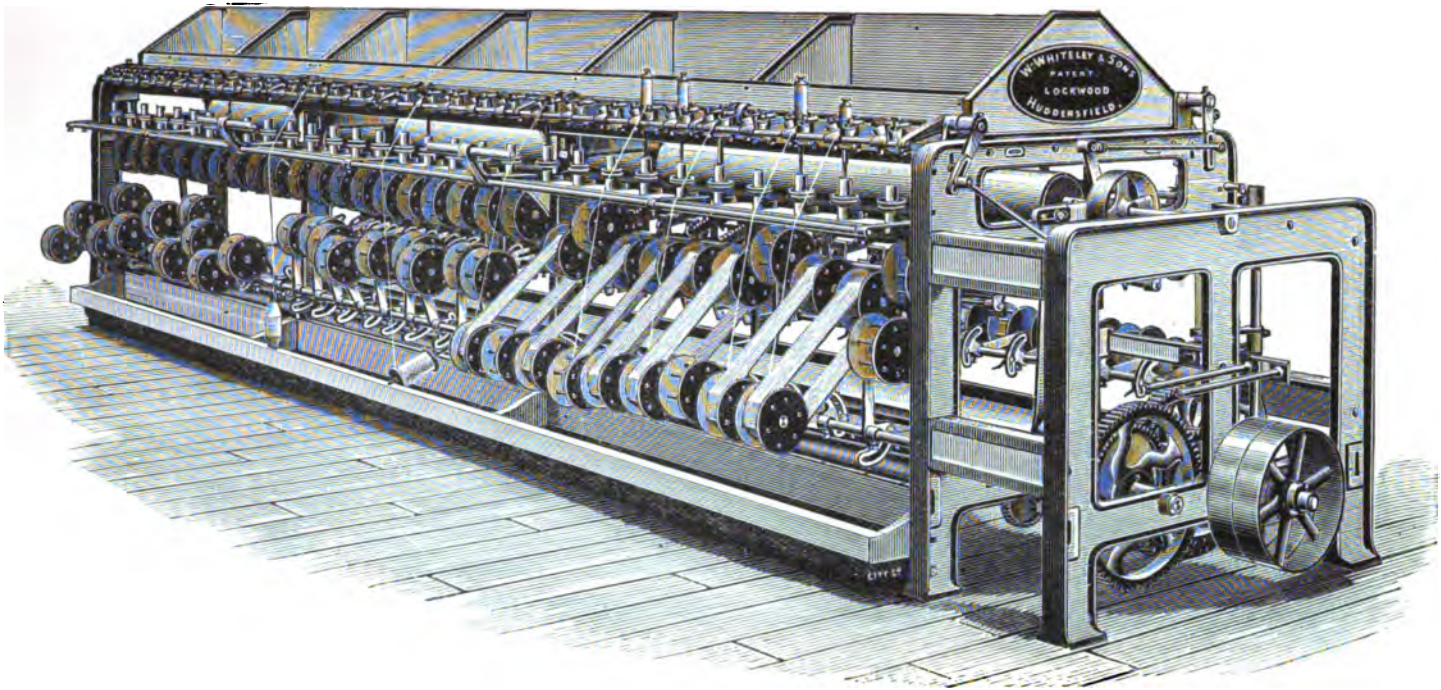
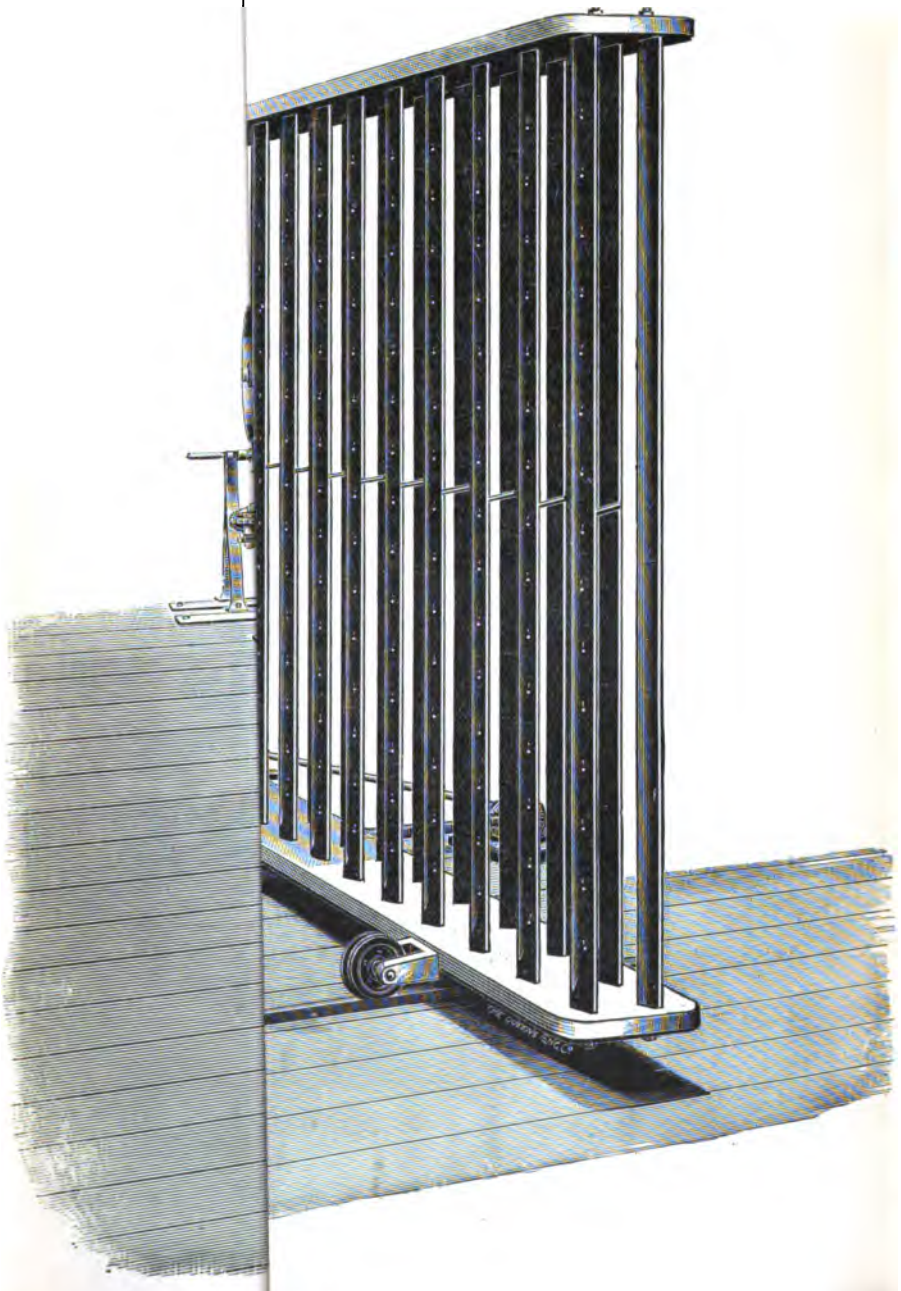


Figure 20. YARN WINDING MACHINE. (Wm. Whiteley & Sons Ltd., Huddersfield.)



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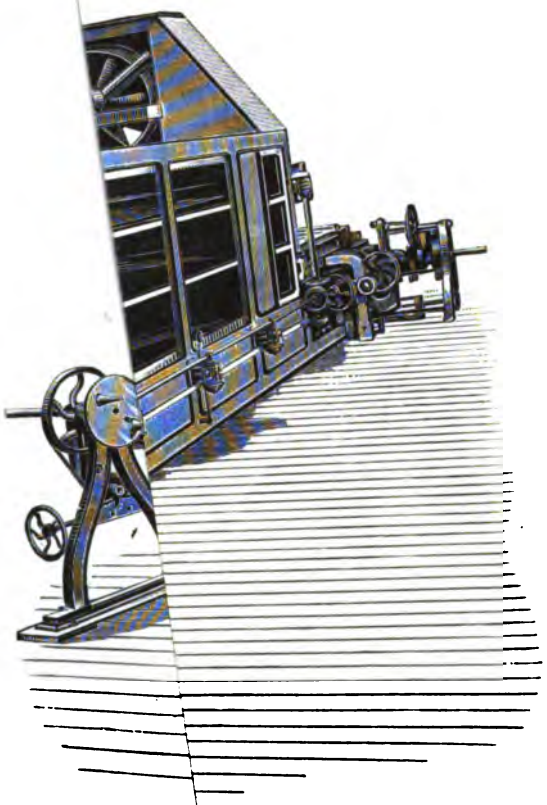

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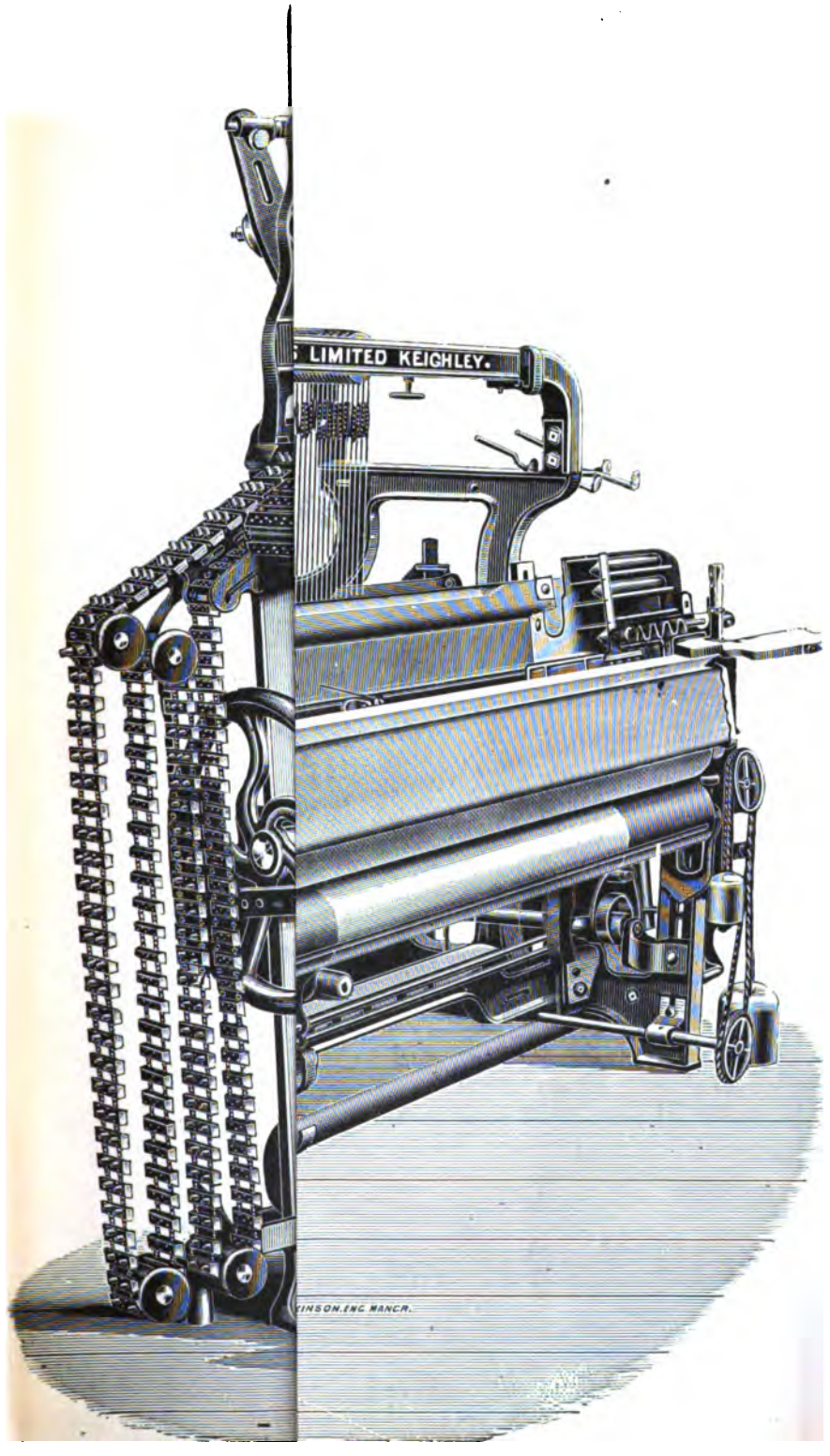
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a gelatinous solution—and afterwards squeezed through rollers; but as a rule this is now done on a combined sizing, drying, and beaming frame (Figure 22), in which the web is carried through a trough of hot liquid size, and then through a pair of squeezing rollers; it is gradually opened out, cooled, and dried as it travels backwards and forwards in the cooling chamber, and is finally evenly wound on a warp-beam ready for the loom. The warp is wound on the warp-beam at a specified width and "set," the width referring to the width of the warp on the beam, and the "set" to the number of threads per inch, or rather to the number of "porties" per "quarter," a "porty" being about 38 threads (the number varies in different districts), and a "quarter" being a quarter of a yard, or nine inches of width. Thus a warp "eight quarters wide" "twelve set" will contain 8 (number of quarters wide) × 12 (number of "porties" per "quarter") × 38 (number of threads per "porty") = 3648 threads.

Sometimes a warp is formed and sized in sections. The bobbins of warp are again placed on a creel, the threads conveyed through size, squeezing rollers, and drying chamber, as before, or around heated drying cylinders, and wound on a section or "cheese." A given number of these cheeses is placed in a beaming frame, where the warp from them is wound to the width and "set" required on the power-loom beam.

Weaving. The next process is that of weaving; but as the general principle is so well understood, and there is such a variety of looms in use, a brief description of a representative loom will suffice. Figure 23 is a loom with 34 shafts, each containing a heald or gear; each thread of the warp passes through a loop or "noose" of one heald or gear; there are therefore 34 separate sections of warp that can be raised or depressed (or "shedded," as it is called), as required. This admits of a great variety of patterns or designs being produced; the greater the number of shafts, the greater the variety of patterns. With "harness," which operates every thread of the warp separately, unlimited variety may be produced.

The shedding or working of the gears is regulated by the manner in which the pegs in the chain shown at the side of the loom are disposed; the length or extent of the pattern is therefore only limited to the length of the chain, which is here shown very short. The loom also contains, on each side, four boxes or compartments

for shuttles containing the weft; four different kinds of weft may therefore be thrown or "picked" across the warp, in such order as the pegging of the longer chain, which controls the movements of the shuttle boxes, may determine. Two or more varieties of warp may also be introduced by having two or more beams at the back of the loom. It will thus be seen that it is possible to introduce an immense variety of design, colour, and material in a loom of this description.

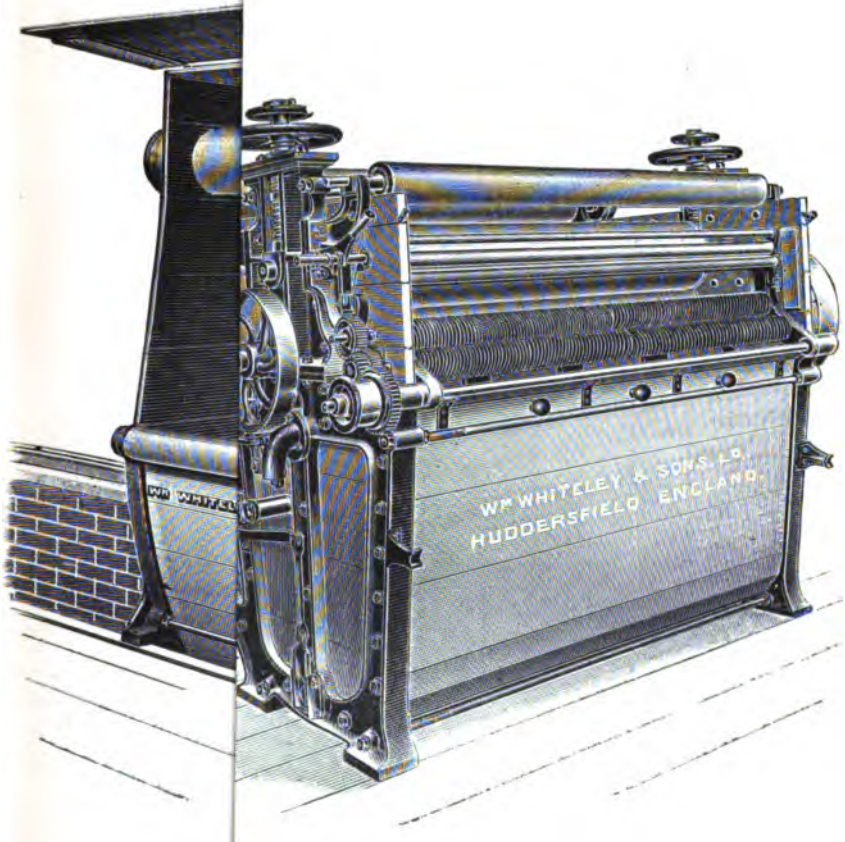
Although a little may be done in the twisting department, it is in this stage of the manufacture of worsted coatings that adulteration, to any extent, first becomes possible. The cloth may consist entirely of cotton warp, or, by means of the shedding and picking arrangements described, the cloth may consist, as it often does, of a thin veneer of worsted, backed by yarn manufactured by the woollen process, and made of the lowest materials which the woollen process permits.

On leaving the loom, the end of cloth, or "piece" as it is called, is "knotted and mended," a manual process, in which all defects are repaired; and it is then ready for the cloth finisher.

Cloth Finishing. The first process in finishing is scouring, which in low goods is sometimes omitted. The piece is run over rollers, in a sort of well, first in suds and afterwards in running clean water, in an ordinary cloth-scouring machine (Figure 24).

Figure 24A is an improved type of cloth-scouring machine; its feature, is that instead of the cloth being "bunched up," it is kept, whilst running through the suds, or clean water, as the case may be, out to its full width by means of "scrolls," the rollers seen in front of the machine with spirals running outwards from the centre.

After scouring the piece is, as a rule, taken to the "steam crab" (Figure 25). The cloth is passed, at its full width, through hot, and sometimes boiling, water; it is then wound on to a perforated copper roller, and a wrapper, wide enough to wrap over the ends of the piece, is put over the whole. The roller, with the piece on it, and wrapped up as described, is then screwed to a tap connected to a steam pipe, when steam, at from 50 to 70 lbs. pressure, is blown through the piece for a length of time varying according to the porosity of the cloth. This is "crabbing," which to some extent is analogous to "fulling" or "milling" in a woollen mill; its object,



IMPROVED CLOTH-SCOURING MACHINE.
(Whiteley & Sons, Ltd., Huddersfield.)

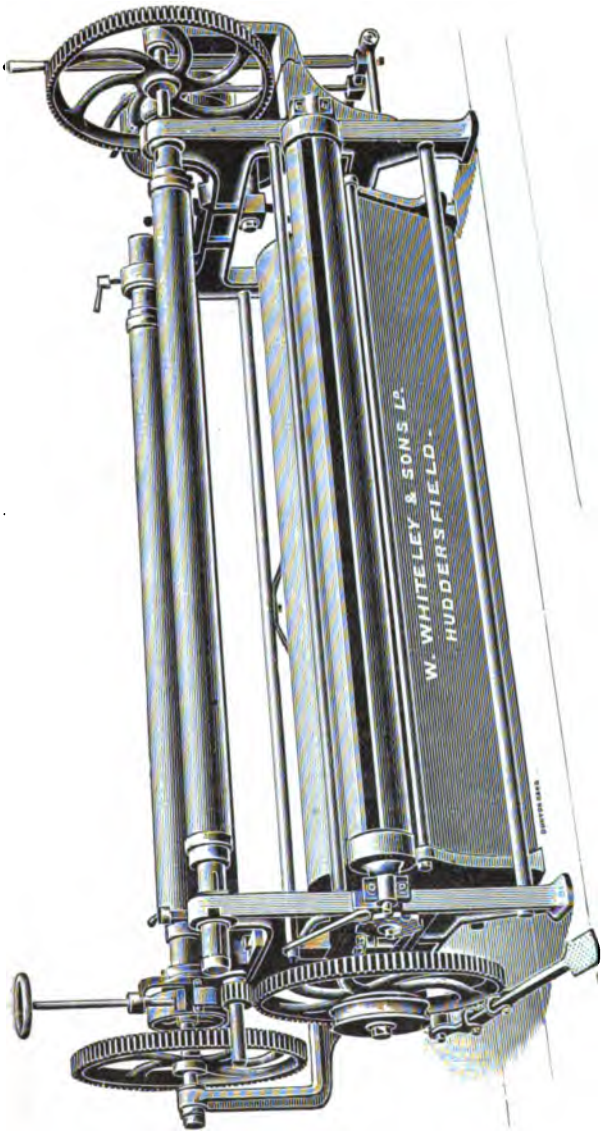


Figure 25. WINDING-ON FRAME, OR STEAM CRAB. (Wm. Whiteley & Sons, Ltd., Huddersfield.)

Figure 26. Hydro Extractor. (Wm. Whiteley & Sons, Ltd., Manchester.)

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however, is not to "full" the piece, but merely to set the fibres, and to prepare the face of the cloth for receiving the desired finish.

The piece may then be dyed, a process which is, of course, omitted in mixtures, and after dyeing it is again washed, but this time in cold water with fuller's earth; it is then taken to the hydro-extractor (Figure 26), a cylindrical iron case, having inside a wire cage carried on an upright spindle. The piece is put in this cage, which, by revolving at a very high speed, expels the water by centrifugal force; the outer case is suspended from pivots, which lessen to a considerable extent the vibration generated by the high speed at which the cage is driven.

The wet piece is then dried and tentered in the steam "tentering" machine (Figure 27), which is in an enclosed compartment. The piece is attached by each edge, selvege or list, to a travelling chain, and by it slowly conveyed backwards and forwards, over and under layers of steam pipes; as the chains travel, they gradually draw wider apart, thus stretching or "tentering" the piece to the required width, and drying it at the same time.

Figure 27A shews, in section, an "exhaust" tentering machine, in which the piece, whilst being tentered, is dried by means of the exhaust fan and chamber at a much lower temperature than in an ordinary tentering machine.

To obtain a soft feel or "handle," the piece, after tentering, is usually damped in a dewing machine, in which the piece passes before a row of fine jets or "nozzles" from which water is blown upon it in the form of spray. Figure 27B is an improved type of dewing machine; in this the piece is run over a lead-lined trough in which is a brush revolving at a very high speed, which takes up a definite quantity of water from a wood roller revolving in water in the trough; the brush distributes the water in the form of fine dew or mist upon the piece as it passes over it.

The piece is sometimes taken to the "steaming and brushing mill" (Figure 28), where steam is blown through it as it passes over a perforated steam-pipe in the trough in front, after which it is brushed by means of revolving brushes. This straightens and slightly raises the wool on the face so as to prepare it for the cloth-cutting machine or "Perpetual."

If it be desired to produce a soft woolly back, the piece is raised or "teazed" on the back in an ordinary cloth-raising "gig" (Figure 29), a machine in which a large cylinder, set with teazles, revolves

rapidly whilst the piece is passed over it; this is usually done in the wet state, after scouring and crabbing.

From the tentering machine, or the brushing mill, as the case may be, the piece is taken to the cloth-cutting machine or "perpetual" (Figure 30), in which it passes under a revolving spiral knife, which shears all superfluous hairs from the face, leaving the design more or less clear and distinct as required.

The piece is then shrunk, usually by being drawn, at its full width, through cold water, and squeezed almost dry between a pair of spongy rollers, and left to dry completely by natural evaporation; after which it is sometimes cold pressed, but more frequently hot pressed, by being folded in layers, a sheet of press paper placed between each layer, hot iron plates at intervals between the folds, and the whole subjected for a while to powerful pressure in a hydraulic cloth press (Figure 31).

The piece is then slightly steamed on the face, in a steaming machine somewhat similar to Figure 28, in order to take off the superfluous gloss or "shine" acquired in pressing, after which it is "cuttled" in folds, or rolled on a board, when it is ready for the market.

And now, gentlemen, having dealt with the subject in its technical aspect, it only remains to consider it from a Fire Insurance point of view; and here the field is limited, for I must confess that I recognise very few special elements of fire-risk in purely worsted processes. There, are, however, one or two, to which I may draw your attention.

Gearing. The gearing boxes, especially in the card room, where there is a considerable amount of "fly" (and my remarks apply to any textile factory), are often merely receptacles for the accumulation of grease and fly; and it is not all unusual to find the gearing embedded in fly saturated with wheel-grease. The danger here is obvious, and, in my opinion, it would be better, where inside gearing exists, to have a metal shield, without top or bottom, round the gearing, and a metal dish a few inches below the bottom of the shield, so arranged as to catch all drip, and shallow enough to ensure frequent emptying.

Heating. In many mills the steam pipes for warming the rooms are laid on the floor; greasy waste and sweepings (and, more particularly, greasy "fud" in woollen mills) are sometimes allowed to accumulate on or

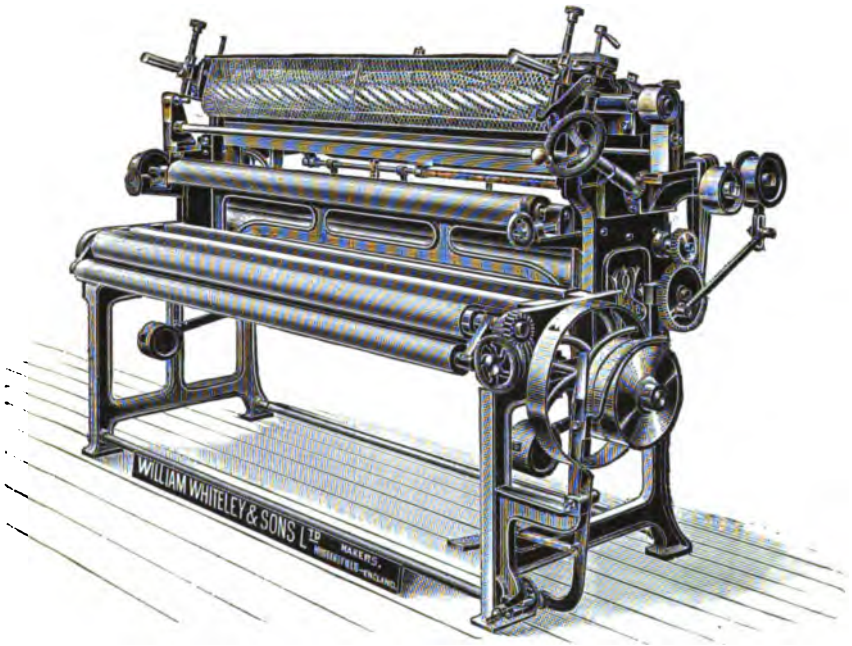

Figure 30.—Cloth-Cutting Machine, or "Perpetual."
(Wm. Whiteley & Sons., Ltd., Huddersfield).

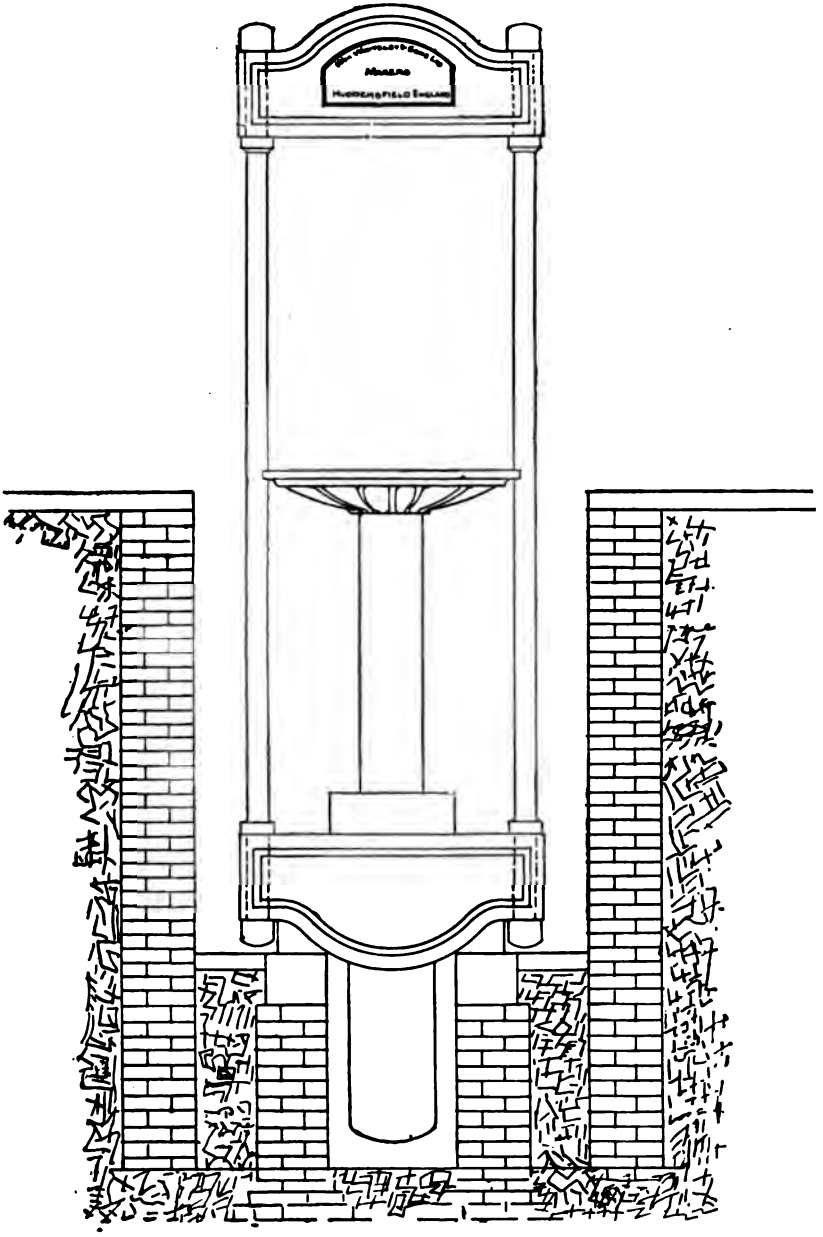

Figure 31. Hydraulic Cloth Press.
(Wm. Whiteley & Sons, Ltd., Huddersfield.)

near the steam pipes, very often left over-night, and a fire is not unfrequently the result. In my opinion, Insurance Companies should insist upon all steam pipes being fixed overhead where it is possible to do so, and at some distance from the walls. Where, however, it is absolutely necessary to carry steam pipes along the floor, or on the walls below a height of say six feet, as may sometimes be the case with inlet and outlet pipes, pipes for supplying steam to certain machines, &c., all such pipes should be well coated with non-conducting material, and boxed off for the protection of the covering.

Oil. In machines where steam-heat is employed, and in others where certain parts run at high speeds, such as the spindles in spinning and twisting frames, the use of a lubricating oil of a low flashing point is undoubtedly a source of danger, and it might be well for Insurance Companies to consider whether they ought not to exercise some control over the use of lubricating oils, somewhat on the lines of those adopted with regard to the use of blending oils.

Willeying. There is an element of danger where a "Fearnought" or willey is used, but not to the same extent as in a woollen mill, seeing that the material contains no cotton or "other vegetable fibre," and, if any oil, only a very small quantity, and that, as a rule, pure olive.

Carding. In the card room there is often an element of danger, which, although much more pronounced in a woollen mill, it may not be out of place to refer to here. My remarks apply only to "carders" after the style of a woollen "scribbler." The raw material, as it passes through the feed-rollers, first encounters the "licker-in," a roller studded with teeth about a quarter of an inch apart, and revolving very slowly; now, if there be any hard substance in the raw material which fails to drop between the feed-rollers and the "licker-in," it will, in all probability, be brushed off by the "stripper," which carries the material from the "licker-in" to the breast, there being ample space between the two latter rollers—in fact, the "licker-in" arrangement is chiefly for that purpose—or it may become embedded between the wide teeth of the "licker-in," out of harm's way. Since the introduction of hardened and tempered steel wire card-

clothing, which is sufficiently strong and rigid to deal with the raw material first hand, many Manufacturers, to avoid waste (for the "licker-in" drops a certain quantity of material on the floor), have dispensed with the "licker-in." herefore, if, in such cases, there be any hard substance in the raw material, instead of its being received by the slowly revolving "licker-in," with its wide-apart teeth and dropping proclivities, it encounters, whilst held rigidly between the feed rollers, an array of pointed steel teeth in the rapidly revolving breast; the danger here will be apparent, yet it is difficult to suggest a remedy, as one cannot insist upon Manufacturers restoring their abandoned "lickers-in." At the same time it may be worth knowing that there is considerable danger of fire where no "lickers-in" exist (especially where inflammable material is worked up), and that in the place where, so far as regards machinery (the carding-room), the largest amount of damage is likely to be sustained.

Weaving. The special element of fire-risk in the weaving department is in the proximity of the gas lights to the loom gearing, and more particularly where "harness" looms are employed. By the term "harness" loom, I refer to those where every thread of warp is operated singly by a separate cord attachment to the "jacquard" engine at the top of the loom. These are often called "jacquard" looms, but the distinction is not clearly conveyed by that term. The "jacquard," or "shedding-motion," is an apparatus fixed at the top or at the end of the loom, and its function is to raise or depress the respective warp threads, so that the weft thread may pass over or under such of them as the design may require. In this respect Figure 23 is a 'jacquard" loom, but it is not a "harness" loom. In Figure 23 the warp threads are raised or depressed in sections, by means of the 34 shafts; in a "harness" loom there are no shafts, but every warp thread is operated singly by being, as before stated, raised or depressed by separate cord attachment to the "jacquard." It will thus be seen that, although a "harness" loom is also a "jacquard" loom, a "jacquard" loom is not necessarily a "harness" loom. In the "jacquard" loom (Figure 23) there will only be 68 cords, two to each shaft; in a "harness" loom there will, of course, be as many cords as there are threads in the warp, which may be 3000 or 4000, or more. It is in these cords (which are often of cotton, and treated with boiled oil and varnish) that the danger of fire from the proximity of gas lights exists. The gas brackets should be rigid,

fixed at a safe distance from the "harness," and protected by shields.

I take it that the term "jacquard loom" in the Worsted Mill warranties is intended to apply only to "harness" looms such as I have described, and a clearer definition might be desirable; for example, instead of the words "jacquard loom," it might be advisable to substitute the following:—"harness loom, in which the warp threads are raised and depressed singly by means of 'harness' or separate cords."

For the purposes of this Paper, I have applied to the leading makers of worsted machinery for illustrations of their respective productions, and have, in all cases, met with a most cordial response, and I have to thank all the firms whose names are severally appended to their illustrations, for their very kind and ready assistance; I have also to thank Mr. J. B. Roberts for the loan of several of his illustrations of woollen machinery, and for the use of such of his lantern slides as I have required.

J. COOPER EDDISON.

Yorkshire Insurance Institute,
January 17th, 1896.

THEATRES AND MUSIC HALLS.

DURING recent years much attention has been called by the Insurance press and also by the public press to the many fires that have occurred in theatres, music halls, and other places of public amusement both at home and abroad, and the question has been taken up very seriously by many eminent architects, engineers, fire brigade superintendents, and other qualified men who have written papers embodying their views and suggestions on this important subject, but most, if not all these writings have centred round the important subjects of "Construction," "Better Planning," and "Increased Means of Exit," all having for their object the prevention of loss of life in case of panic caused by an outbreak of fire in such buildings. This idea is fully borne out by some remarks made by Mr. Edwin A. Sachs, the theatrical architect, in a paper he read before the British Fire Prevention Committee in 1897. In this paper Mr. Sachs says, "Personally, "I hold that for a theatre or music hall, clear planning is of "greater importance to the audience than clever forms of con-"struction or the employment of materials having considerable "power of fire resistance," and in another part of the same paper he says, "I consider it the duty of the authorities to attend to "the protection of life in the first place, and to the protection of "property in the second." He further states, "We all know how "easily a panic occurs without any fire, and how dangerous the "rush of a frightened audience can be, therefore the clear exit of "ample dimensions and most direct route will be the greatest "safeguard against loss of life."

Mr. Thomas Bashall, Superintendent Architect to the London County Council, in a paper on "Lessons from Fire and Panic," Mr. Alfred Darbyshire, architect, of Manchester, in a paper on "Theatre Exits," and other writers of similar experience, give expression to the same sentiments, and the concensus of opinion of these writers is summarised in the words "better planning,"

which they all agree should be enforced by stringent laws, but which does not yet, unfortunately, find a place on the Statute Books of our country. In London, however, the County Council have grappled with this subject, and have made Theatre Regulations under the Metropolis Management Amendment Act, 1878. These Regulations were enacted on the 9th February, 1892, and apply to all newly-constructed licensed buildings for public amusement within the administrative County of London, and by their application much improvement has been effected for the safety of the public in all modern theatres erected under the direction of the County Council.

These regulations are divided into three parts, viz.,

Part I. contains 29 clauses and provides for—

Planning.
Construction.
Separation of Auditorium and Stage and Dressing Rooms by walls and iron doors.
Number and height of Tiers.
Entrances and Exits.
Proscenium openings to be protected by a Fire-resisting Curtain.
Roof over Stage to be fitted with a Ventilator.
Separation of all Workshops, Store-rooms, Painting Room, Scene Docks, Lime Light Tanks, Engine and Boiler Houses, by brick walls and iron doors.
Gas Lighting and Gas Meters.
Warming and Heating.
Water Supply and Fire Mains.

Part II. contains four clauses and provides for—

Additional Lighting in event of Gas being extinguished by a Fire.
Fire Alarm and Fire Appliances.

Part III. provides for Electric Lighting.

We cannot devote more space to the description of these important rules, but sufficient has been quoted to show the care and attention given in framing them so as to ensure increased safety in the buildings that come under their operation. The requirement of a fire-resisting curtain to the proscenium opening is perhaps one of the most important rules, and is one that should be made compulsory in every theatre and music hall in Great Britain.

These Regulations are not applicable outside the London district controlled by the County Council, but in some modified form they have extended to the provinces, and the requirements have become more generally accepted as their necessity has been appreciated by those municipal and other authorities who have adopted the Regulations; but architects and clients do not, from motives of economy or wilfulness, always carry out the requirements, and until the time arrives when theatre planning is absolutely placed under municipal or State control, with power to enforce strict conformity with the rules and regulations of some recognised authority for the safe construction of theatres and other places of public amusement, the present conditions will continue to exist.

Still, the construction of a theatre or music hall has now come to be regarded as a work of great importance, and the public are no longer admitted to buildings which have not been approved by responsible persons. A rivalry has sprung up amongst the proprietors as to who shall offer the greatest amount of safety and comfort to their patrons, and the result is that the public have largely benefitted by the improvement introduced, and as fire risks they have also been improved, although this important factor to Insurance Companies has not been the primary cause for effecting the betterment.

The Regulations referred to in the before-named Acts are all framed in the interests of the public to protect human life in the case of fire, but have no bearing on the causes or prevention of fires in such buildings; nor have any of the many writers dealt with this side of the question, doubtless for the reason that this comes more within the province of the Fire Underwriter. This paper will therefore be devoted to discuss these buildings as Insurance Risks, and not to traverse the ground that has been so ably dealt with by so many eminent architects, who have made a study of the subject.

Theatres have generally been considered by the Insurance profession as the *most special of all special risks;* the reason for this opinion is difficult to comprehend, unless on sentimental grounds, because, when examined statistically, it will be found that the percentage of fires is not sufficient to warrant this conclusion.

The Insurance mind, however, like the public mind, now and again is alarmed by the destruction of some large theatre, and

there is no doubt that a certain amount of uneasiness always exists on this account amongst those interested, either from a business point of view, or those who find in the drama one of the chief amusements of life. Such a feeling cannot be ridiculed, nor can it altogether be explained away, but an assurance can be given that both classes of mind may perhaps very easily over-rate the danger attached to theatres and other places of public resort. It is quite true that in the last half century a large number of the finest temples dedicated to Thespis have fallen a prey to flames; but, upon careful consideration, it is a matter of surprise that such disasters have not been of more frequent occurrence. Any one familiar with the older theatres in different parts of the country knows that, judged by modern lights, they have been regarded as marvels of faulty construction, and yet many of these exist even in the present day. We have constant experience of fires in other property, such as, for instance, mansions, warehouses, and manufacturing works, also conflagrations like the Chicago and Boston fires, and later still the Cripplegate fire in London, the Ottawa timber fire, and the recent Montreal and Melbourne fires, but these disasters do not appear to influence the Insurance mind to treat in the future the various risks and places involved as "specially hazardous," but are simply regarded as incidents of fire business. With theatres, however, the case appears, for some reason or other, to be different, and it may arise from that dread of loss of human life which is always present to the mind in connection with fires in places of amusement, and which does not exist to anything like the same extent in other fires. This theory is somewhat borne out by a book on theatre fires written by Herr Folsch, and published in 1878, which deals with the number of fires *and the loss of life entailed* by these fires for a period of 100 years from 1778 to 1878, "during which time it appears there were 460 theatres, valued at "£25,000,000, destroyed, and *some thousands of lives lost* in the "flames or by the panics that ensued upon the discovery of the fires." This work principally deals with Continental and American fires, where the loss of life has been the greatest, though we have not been free from those calamities in our own country—notably the Exeter disaster in 1887, and the more recent disaster in 1891 in Gateshead Theatre Royal, by which fires many lives were sacrificed.

The loss of life in places of amusement is, however, very small in comparison with the number of people (estimated at 260,000)

who nightly attend entertainments, and in this connection we would quote from a letter written on the subject in 1877 by the veteran theatrical manager, Mr. John Hollingshead, late of the Gaiety Theatre, London:—"He states that the result of enquiries "and researches which had been made for him by an eminent "actuary that in the whole of England, for the last 50 years, with "ill-constructed, overcrowded, and badly-surveyed theatres, he "could only find a record of one solitary death from fire, and when "the actuary takes this unit of mortality, and makes his calcula-"tions as to the playgoer's risk of a fiery death while attending a "theatre, he comes to the conclusion that it may be put at about "a billion to one."

This quotation is given for what it is worth, but as it is the only actuarial opinion on the point with which we are acquainted, we desire to put it on record as a protest against the theory we have advanced that the loss of life caused by fires in theatres is the reason these risks are looked upon as "specially hazardous" by Insurance Offices, but we would rather take a broader view of these risks, and consider them from a purely business aspect. All theatres and music halls are commercial undertakings, in which large capitals are invested in buildings, plant, and properties, and require the protection of Insurance on the same principles which govern other business enterprises—treating them on their merits without prejudice, due weight being, of course, given to every hazardous feature they possess, and also to the experience obtainable over an average number of years, and it is to this side of the question that we wish to direct attention.

In the United Kingdom of Great Britain and Ireland (and in passing we would observe that we only propose to deal with places of amusement in the British Isles) there are 351 theatres and 169 music halls at the present time, ranging in value from £1000 to £100,000 each, and taking a rough average of £10,000 each for the theatres and £5000 for the music halls, the capital invested amounts to the following large sums, viz.:—

351 theatres at £10,000 each, . .	£3,510,000
169 music halls £5000 . . .	845,000
	£4,355,000

This approximate value is rather under than over the actual amount invested in these undertakings, and the income derivable

from this source of business deserves that some thought and study should be expended in ascertaining the physical hazard connected with these risks.

Theatres and music halls have many features of hazard in common, but the former possess some that do not exist in the latter, and vice versâ; so, to prevent confusion in defining "hazard," it will be more convenient at this point to divide the two classes of risk, taking first the theatres and afterwards music halls, and by this means avoiding the overlapping of technicalities that are not applicable to both.

Taking theatres first, as the more important of the two. The requirements of a building for theatrical purposes necessitates that it shall consist of at least three parts, divided into—

Entrance and auditorium,
The stage, and
The dressing-rooms,

each part being separated by brick cross walls well bonded into the external walls. The entrance and auditorium are also generally divided by a cross wall, but this wall is pierced by so many doorways that these two parts are practically one.

The auditorium and stage are divided by the proscenium wall, which should rise from the foundations of the building and pass up to and above the roof, with as few openings therein as possible. The London County Council limit the openings in this wall to three—viz., the proscenium opening and two ordinary door openings, but this rule is not carried out in the provinces, except in cases of good modern theatres built under the London regulations.

The proscenium opening is, from a fire point of view, the most dangerous of all the openings in these cross walls, owing to the inflammable nature of the attached curtain and the scenery on the stage, for when a fire occurs it invariably breaks out on the stage amongst the scenery and the whole is ablaze at once, and it is to the "physical hazard" of the stage that special attention should be directed. The auditorium and dressing-rooms contain no special elements of risk in themselves, but only from their direct communication or contiguity to the stage, on which the whole hazard centres. To appreciate the risk in this portion of a theatre, we will refer for a short time to the inflammable construction and materials, and to the artificial lighting in use at all

hazard that always exist on the stage of a theatre.

The stage is constructed of timber, with numerous openings for traps and slides for scenery, and extends past the proscenium wall for a short distance into the auditorium. Under the stage is the mezzanine floor on which the mechanism (chiefly constructed of wood) is placed for working the traps, slides, and scenery, and below this floor is a well or sink for the reception of scenery and sets that are worked from the mezzanine floor on to the stage above. On the mezzanine floor it is not uncommon for small portions to be used for store-rooms, gasman's and electrician's shop, and carpenter's shop, but these are very objectionable features, and add considerably to the fire hazard.

Above the stage, and on either side thereof, are narrow galleries or "flies," from which the ropes connected with the scenery and sky borders are worked, and to convey an adequate idea of the number of these ropes, we cannot do better than compare these "flies" to the bulwarks of a large sailing ship, where all the rigging and ropes for the manipulation of the sails are fastened. Over these "flies," and over the whole of the stage, and just under the roof, is a wood batten flooring called a "gridiron," and from this "gridiron" all the cloths, sky borders, and gas battens are hung by hemp and wire ropes worked from the "flies."

In the roof, over the "gridiron," a large ventilator should be fixed to carry off the fumes of the gas, and in case of fire it would also tend to draw the flames and smoke from penetrating into the auditorium, and this is one of the essential rules in the Theatre Regulations of the Metropolis Management Amendment Act, 1878, before mentioned.

The stage, scenery, and the other inflammable materials just described constitute the first elements of risk, and the second—and by far the greater factor of fires—is the artificial lighting necessary for presenting scenic representations to the public. The general illuminant used is gas, fitted and used in a variety of ways, but in whatever part gas brackets are used they should be "stiff" and fitted with glass or wire globes, and no swinging pendants nor jointed brackets should, under any circumstances, be used on the stage, auditorium, or dressing-rooms.

The lighting of the stage is the most important feature in this connection, requiring hundreds of lights divided over the whole area to produce the desired scenic effects, and as many of these

lights are amongst the scenery there is constant danger from this source from the time of lighting up until the close of the performances. The lights consist of a row of "footlights" fixed in a sunk well, lined with iron or tiles, in the front of the stage, also head-lights or "gas battens" fixed amongst the borders over the stage. There are four or five of these gas battens (the number varies with the depth of the stage), and each batten contains 60 lights fitted in a horizontal gas tube attached to an iron frame of a

shape with bent wire netting to the open parts to prevent the surrounding scenery coming into contact with the naked lights. These "battens" are also made of wood, lined with sheet-iron, but those constructed entirely of iron are much the safer of the two kinds of "battens" in use. These "battens" are suspended from the "gridiron" over the stage above the top of the proscenium openings, and can be raised or lowered as required, and being thus movable lights, the gas has to be conveyed to them by means of flexible piping from fixed mains in the "flies." It is very essential for safety from fire that these "battens" should be hung quite clear of all the scenery and borders, because there is always the danger of such scenery or border coming into contact with the batten, either whilst they are being raised or lowered or through being wafted by the air currents caused by the great heat generated from the gas, and too much attention cannot be given to the protection of these lights from contact with the inflammable materials with which they are surrounded, but where proper network is provided they are comparatively safe.

In addition to these lights, it is necessary, in order to produce the sudden effects of light and darkness, to have ground and wing lights which are temporarily used, and, from the nature of the case, these must be very easily removable in a few minutes when the scenes are required to be changed. The ground lights consist of a horizontal gas tube fitted with burners and fixed in long iron frames laid on the stage on iron trestle legs, and the wing lights are of similar construction and are usually hung on the scenes, and both are connected to the gas mains by means of movable wired tubing to water joints which are fixed under the stage and just como flush with the stage floor. When this kind of joint does not exist, the old style of supplying the gas consists of an ordinary tap, the spindle of which also comes up nearly flush with the stage floor, and a key is used to turn the spindle when required,

tap is shut on, but as all the scene changes are done very hurriedly, it often happens that several of the taps are not properly closed when they ought to be, and consequently there is a large escape of gas, which is very dangerous, and frequently results in "flares" and stage fires. To overcome the dangers arising from this old system, the "water joint" has been introduced with lower tap attachment, which shows at a glance whether the tap is properly closed or not. This consists merely of a lever coming from the tap to the stage floor, and to which is attached a cover-plate or lid, which serves the double purpose of acting as a handle to open and close the tap and as a cover for the hole in the stage floor when the movable pipe is removed. When the cover is down, it is known the tap must be closed and no escape of gas is possible, hence the safety of these water joints over any other system.

There are also standard bunch lights used in the wings, which are the only kind of wing lights now allowed to be used by the municipal authorities, and these are supplied with gas in a similar manner to the ground lights, and notwithstanding the illuminating power already described it is not always sufficient, and limelight is largely resorted to for producing brilliant and coloured effects, and these limelights are generally in iron boxes closed on all sides except the front, and are supplied with hydrogen and oxygen gas by wired rubber tubing from iron pipes at the nearest point, which is disconnected as soon as the requirement for their use is over. These limelights being movable cannot have fixed connections.

Such are the principal means of lighting the stage, and owing to the number of lights in use for so many hours each night it will be appreciated, from the great heat constantly being given off by these hundreds of gas jets, that all woodwork in a short time becomes thoroughly dessicated and like so much tinder, which a small fire or even a spark will kindle, and which would in all probability result in a serious destruction of property from the very inflammable materials on and above the stage, and as this is an ever-present danger all scenery ought to be saturated or painted with a solution of tungstate of soda and primed with silicate of soda or some other fire-resisting solution, and all woodwork treated in a similar manner, which would render both cenery and woodwork non-inflammable, and thus greatly

portion of a theatre risk.

The gas for the supply of all the numerous lighting arrangements mentioned is all controlled from the "prompt" side of the stage, with separate stop taps to each distinct service, and separate meters for the stage and for the auditorium, and these two supplies ought to be cut off every night by a stop cock in the street, so that no gas remains in the building after the close of the theatre.

The introduction of the electric light to supersede gas as an illuminant will have the effect of reducing the fire hazard, provided that installations are fitted according to the Fire Offices Rules, but the electric light has dangers of its own, and requires constant attention by an electrical expert, because this new light is often put to temporary uses for scenic effects, and unless these occasional lights are properly connected by safe wiring under the supervision of an expert there is a hidden danger that does not exist in gas; at the same time with proper installations and competent supervision the risk of fire should be reduced by this means of lighting the stage.

Apart from the "physical hazard" already mentioned, there is the further one of scenic effects incident to all performances in a more or less degree and too numerous to mention within the scope of this paper, but a few of the principal ones may be indicated to illustrate our views on this point.

The increasing demand for spectacular displays has caused a constant supply of elaborate productions in burlesque, operas, drama, and pantomimes, with the attendant highly inflammable scenery and other hazardous scenic effects, such as carnival scenes, in which lighted torches or Chinese lanterns are used—pistol and gun wads or cartridges fired on the stage may lodge unperceived amongst the scenery or decorations, smoulder, and eventually burst into a blaze after the performance is over. In such a manner the theatre at Belleville in Paris and the Varieties Theatre in Plymouth were destroyed. Another source of danger is "snow" for a winter effect. It appears paradoxical to put forward "snow" as a fire hazard, but it must be borne in mind that we are dealing with illusions or stage effects, and stage "snow" was the cause of a serious fire at the Grand Theatre, Islington, in February, 1900.

This "snow" consists of small pieces of paper placed in a V-shaped longitudinal box suspended from the gridiron over the

fall from the box gently on to the stage. If this "snow" box is not carefully fixed below the "gas battens" the paper on falling may lodge on the nearest "batten" frame, and although the gas may not be lighted in the particular batten the next time it is lighted the paper on the batten frame may be ignited and the fire extend to the adjacent "borders," and this was what actually occurred at the Grand Theatre fire at Islington. Such a danger ought not of course to exist, but that it does the above example confirms, and in our own experience we once discovered the top of a "gas batten" covered with stage "snow," and had it removed before leaving the theatre.

These scenic effects are, however, part of the risk of modern theatres and cannot be interfered with nor prevented, but there are other scenic effects which appear from the auditorium to be exceedingly hazardous but which are quite harmless and from which no fire may be apprehended, such, for instance, as lightning, burning of houses, and blowing up of buildings.

Forked lightning is produced by an electric light or a limelight being flashed behind cloud scenery in which there are zigzag openings covered by some transparent material. Sheet lightning is effected by lycopodium being blown in puffs through a spirit flame in an iron pipe bowl. The blowing up of houses in some sensational drama appears a terribly risky performance, but there is really no fire danger attending such a scene, the operation being done by gunpowder, lycopodium, and sawdust placed in an iron vessel, and the sawdust at the bottom is fired by a train of powder through an iron tube that runs out from the bottom of the vessel. The lycopodium and sawdust give off a lurid flame, the powder causes the smoke, and the explosion is effected by a small battery or quick-firing rifle.

The burning of a house on the stage seems to be courting the disasters of a real fire, but when it is understood that this effect is produced by burning powdered resin in an iron pot or by an arrangement of tow sprinkled with methylated spirit, it will be seen that there is not so much fire risk in this illusion as may appear.

Apart from the hazards already named it is not an uncommon thing to find extra risks existing through the storage of old scenery, properties, and rubbish under the stage and in out-of-the-way places, carpenters' and other workshops and temporary

dressing-rooms constructed of timber, also under the stage, which are all very objectionable features and ought not to be allowed, as the natural physical hazard of the stage needs no extra hazard arising from these features, which ought to be in distinct places, and in well-managed theatres no such extraneous risk is allowed to exist under or in connection with the stage, which is in accord with the London County Council rules on these points.

There is one more feature of risk that we ought to mention before leaving this part of our subject. We refer to the cigarette-smoking on the stage, and also in front of the house between the acts, which has grown to such an extent in late years as to compel managers to provide smoking-rooms for the modern generation who cannot allow a couple of hours to elapse without the stimulant of tobacco, and in theatres where no smoking-room exists cigarettes and cigars are freely lighted in the passages, lobbies, and approaches in defiance of all rules, the matches and lighted ends being carelessly thrown down anywhere, without regard to consequences, directly the performance is renewed.

These, briefly, are some of the more prominent features of fire hazard in all theatres, but they are not so great, in our opinion, as is generally supposed, though we do not wish to convey an idea that there is no risk; far from it, as the many fires that have occurred is strong evidence to the contrary; but if the statistics of fires in this class of risk are examined for the last ten years they will show whether this experience will bear out our contention, for an opinion to be of any value must have facts and experience for its foundation, and the experience of the last 10 years should be sufficient to disprove or support our position.

During the period named there have been 50 theatre fires reported, which occurred during the following months of the years, viz.:—

15	between	January	and	March	(Winter).
10	,,	April	,,	June	(Summer).
11	,,	July	,,	Sept.	(Summer).
14	,,	October	,,	Dec.	(Winter).
—					
50	58 per cent. for the Winter months (29).				
—	42 per cent. for the Summer months (21).				

The times when the above fires occurred will be instructive, and are as follow, viz.:—

5 from 3 a.m to 6 a.m.
20 „ 6 a.m. to 6 p.m.
—
50

The causes of these fires are not always ascertainable, but we give a list of assignable causes given at the time of fire, viz. :—

1 from accumulation of rubbish under stage.
1 property room.
3 from defective flues.
2 from defects in roofs.
6 from lights thrown down.
2 from cigars and cigarettes thrown down.

17 from stage fires, viz. :—

11 from gas and lime lights in contact with scenery.
2 „ lighting up of gas on stage.
2 „ gas escaped and limelight explosion.
1 „ scenic effects—rifle wads.
1 „ „ „ snow on gas battens.
—
17

4 from supposed spontaneous combustion of scenery in store.
2 from workmen.
1 from lightning.
1 from steam pipes.
10 from unknown causes.
—
50

The statistics of fires just quoted, giving the number of fires for 10 years, bring to light that the largest number of fires, 58 per cent., occur in the winter months from October to March, and on referring to the time of these fires it would appear that 60 per cent. of them happen during the performances or within six hours afterwards, which may fairly be put down as a result of such performances. The "causes of fires" also confirm this view, and point to the stage as being the place where most of the fires originate. Thirty-four per cent. of the total number and probably some of the 10 unknown cases occurred also on the stage. This fact emphasises our previous remarks that the stage is the most hazardous part, and the proscenium opening on the stage ought in all cases to be divided from the auditorium by a fire-

resisting curtain, and wherever this protection does not exist the risk should be penalised until such protection is afforded. As an illustration of the efficacy of fire-resisting curtains we may mention that in the 50 fires mentioned six were fitted with curtains of this description, four of them saved the auditorium through being down at the time of the outbreak of the fire, but the other two theatres were entirely destroyed owing to the curtains not being down when the fires occurred, but in all probability the auditorium of these two would also have been saved if the fire-resisting curtains had been lowered, which through some cause appears not to have been the case.

In addition to fire-resisting curtains, fire-extinguishing appliances ought to be provided in every theatre. The stage and flies should be supplied with wet blankets or rugs and buckets filled with water, and hatchets, hooks, and other appliances for taking down scenery in case of fire should always be kept in readiness for immediate use. Hydrants should also be fitted on each side of the stage, flies, and floors under the stage, also on each tier of the auditorium, but the most important hydrants are those in the "flies," as they are on a level with the hanging "borders" and "gas battens" over the stage, and the prompt use of these hydrants will arrest a fire before it can assume any proportion. These appliances should be under the control of a competent fireman during the performances, who from his experience will recognise the possibilities of danger from fire, and who would act with decision in case of an outbreak.

An installation of automatic sprinklers fitted over the stage would be an additional means of extinguishing fires, and although there has not been any actual experience of the efficacy of these installations in theatres, we have every confidence that they would render good service in case of fire amongst the scenery.

The subject of theatre risks is too large to compress into a paper which has to be bound by limitations, and we have therefore confined our remarks as far as possible to the "physical hazards" that we know exist, and also to remove, if possible, the impression that these risks are "specially hazardous." We believe that with "good planning," as provided by the London County Council Rules and Regulations, combined with good management, theatres might be made an acceptable class of risk, and before leaving this part of the subject we must briefly refer to the important factor of management. By good management we do not

management that provides an efficient working staff for all the varied requirements of theatrical business, which necessitates the services of the following artificers, viz. :—

Master carpenter,
A gasman or electrician,
Property master,
Head flyman,
Head cellarman,

with competent staff of assistants, and this staff should be found in all theatres in London and the large provincial cities, but in small provincial towns the expense of such a staff is beyond the means of the management, and one artificer will have to perform the duties of two or three men, and as he cannot possibly discharge them all efficiently, the risk of the small provincial theatre is increased, but as this is unavoidable under the circumstances the fact has to be faced and the risk rated on its merits, as it would manifestly be unjust to class such risks with those provided with an efficient working staff in the larger provincial theatres. At the same time we do not intend to convey an impression that the smaller provincial theatres are inferior risks, but only relatively in comparison with those in which the management have opportunities of supplying a full working staff.

MUSIC HALLS.

Turning now to music halls, which we were obliged to eliminate in treating of the "physical hazard" of theatres, because the two classes of risks were not on all fours all round, there has in recent years been a great development in these risks, and the modern music hall has now become a rival to the theatre, and has to offer a superior class of entertainment, which necessitates similar construction to the most modern theatre, so far as regards the auditorium, stage, means of lighting, etc., therefore many of the "physical hazards" that we have already mentioned exist in a modified or an intensified condition, to which we will shortly refer.

There are 169 music halls in the United Kingdom at the present time, ranging in value from the modest few hundred

pounds up to £100,000 invested in the palatial halls in London, and in this connection we noticed in a recent paper on the "Commercial Drama," read by Mr. Cecil Raleigh, the dramatist and theatrical critic, that Mr. Moss, managing director of the great music-hall syndicate, had informed him that they had a capital of £1,400,000, and controlled 25 halls. They employ 900 artistes per week to appear upon their stages, 1750 stage hands and mechanics, 500 musicians, and the average amount of salaries they pay is £8000 per week. This firm's halls are amongst the most expensively built and furnished in the country, but there are a far larger number of smaller and less ornate buildings, and in arriving at an estimate of the value of the 169 halls, an average of £5000 for each is considered a fair sum, and this would give a capital of £845,000 invested, which should be of interest to Insurance Offices catering for this class of business.

The modern music hall is provided with a stage separated from the auditorium by a brick proscenium wall, and in some cases protected by a fire-resisting curtain, but chiefly by ordinary curtains, and the scenery on the stage consists only of a few drop curtains and borders. It is lighted by gas and/or electric light in a similar manner to theatres, but as there are not the same kind of scenic representations nor scenic effects required, the danger of scenery coming into contact with the artificial lighting is diminished, though it is not altogether absent. There is, however, always the hazard of special variety artistes who introduce smoking, firearms, fireworks, electric light, and cinematographs into their "turns," and as sensational items of every kind are the order of the day in these halls, all the risks attending such displays have to be allowed and taken into account as part of the ordinary performances, and considered in estimating the risk of a modern music-hall stage. The auditorium, in our opinion, unlike the auditorium in theatres, is a greater source of fire hazard than the stage, owing to the "smoking" allowed to be indulged in by the audience from the opening to the close of the performance, but we must admit at once that this opinion is not borne out by any ascertained experience, for in none of the fires which have occurred during the last 10 years can we find any single instance of "smoking" being the reason for any such outbreak; there have, however, been 10 fires recorded from "unknown causes" during the period named, and we think we are justified in assuming that some at least of these "unknowns" have been

the audience at the close of the performances.

Fires in music halls have been quite as destructive as those in theatres, and about as numerous, taking the percentage in the existing number of the two classes into consideration. During the last 10 years there have been 23 fires, which have occurred in the following months of the years, viz.:—

5	fires between	January and March	(Winter).
6	,,	April and June	(Summer).
2	,,	July and September	(Summer).
10	,,	October and Dec.	(Winter).
23			

15 or 65·2 per cent. for the Winter months.
8 or 34·8 ,, Summer months.

The time when these fires occurred is as under, viz.:—

9 fires during performances.
6 ,, after performances and up to 3 a.m.
1 ,, from 3 a.m. to 6 a.m.
7 ,, from 6 a.m. to 6 p.m.
23

The causes of these fires are very limited, so far as regards those which have been ascertained, and are as follows, viz.:—

1 from accumulation of rubbish.
7 stage fires, viz.,
6 gas and lime light in contact with scenery.
1 stage fuse.
7 or 30·43 per cent.
4 from cinematograph exhibitions.
1 defective electrical installation on stage.
10 unknown causes.
23

From statistics we have examined, it appears that the fires for the last five years have been very much greater than those in the previous five years, and the number of halls has decreased in the latter period by seven, so that the percentage of loss is even larger. This increase in fires is mainly attributable to the introduction of the cinematograph, there being four fires caused by these exhibitions

during the last five years, but none from this cause during the first-named period. It is rather singular that these fires should have occurred through these exhibitions, because the F.O. Rules for the living picture apparatus have been in existence since February, 1898, and this experience would appear to point out that the Rules are not stringent enough to prevent fires, or else that the apparatus does not conform to the Rules, and we are inclined to think the latter is the real cause, for we know that many of these travelling cinematograph exhibitions are never advised to Insurance Offices, and consequently there is no means of ascertaining whether the apparatus is fitted with the precautions prescribed by the F.O. Rules. However, this is one of the many special hazards to which the music hall is subject, and has to be acknowledged in estimating them as Insurance risks.

We have referred to many of the features of risk in connection with these halls, and we wish again to refer to the large number of fires from "unknown causes"; 10 out of a total number of 23 fires, or 43·48 per cent., is a very heavy percentage, and it is very unsatisfactory, as there may be other causes of hazard with which we are not acquainted, covered up amongst the "unknowns," but until we have some evidence to the contrary we shall maintain our opinion that most if not all of such cases are due to the "smoking" risk to which reference has already been made, and as this practice is one of the main inducements to the patrons of the halls, this risk, like the poor, will always be with us. We do not propose to refer to the planning, construction, lighting, fire-extinguishing appliances, nor management of these halls, as we have gone into these points fully in dealing with theatres, but we consider they should be subject in every respect to the same suggestions so far as they are applicable, and if both theatres and music halls could be made to conform in every particular to the London County Council Rules and Regulations, or some other authority with power to enforce similar rules, then both classes ought to produce a fairly remunerative business to Insurance Offices.

THOMAS A. BENTLEY.

Manchester Insurance Institute,
April 16th, 1901.

CYCLE FACTORIES.

WHEN accepting the invitation to read a paper on "Cycle Factories" from a Fire Insurance point of view to the members of our Institute, I must confess that I felt the subject was one which should be very interesting to many of our members who, like myself, are votaries of the wheel. The cycle now holds such an important position in social and commercial life that it is not astonishing to find it an object of increasing attention the world over. I propose, in the first place, to give you a short history of the gradual evolution of the cycle from the so-called "Hobby horse" of 1818 to the finished bicycle of 1900. This digression is somewhat foreign to the title of my paper, but the facts are interesting if only to demonstrate that cycling is something more than the passing craze in which light some people are inclined to view the pastime. I use the term "pastime," but I think you will agree with me that the cycle has forced its way into our business lives nearly as much as into our pleasures. When we mount our telegraph boys and postmen on wheels, establish cycle corps in our armies, and use the machine in many other ways too numerous to mention, it seems to me that the cycle is occupying a position in our lives never dreamt of a few years ago.

Numerous theories have been propounded from time to time as to what gave the original inventor his cue, and it is curious to discover that there are distinct references made by old Greek and Roman writers to the mythological gods travelling on wheels. The late Canon Collins in his "Early English Classics" refers to the subject as follows:—Achilles burned to avenge the death of Patroclus, but without armour. Jupiter gave permission to the gods to take sides, and Thetis went to Vulcan, and while she was bespeaking his kind offices in making a new suit of clothes, described the then occupation of the gods, thus translated by Pope—

> "Full twenty tripods for his hall he framed,
> Which played on living wheels of massive gold
> (Wondrous to tell) instant with spirit moved
> From place to place, amidst those blessed abodes,
> Self moved, obedient to the beck of gods."

Have we not here (asks Canon Collins) the idea which gave the original inventor of the velocipede his cue? One German writer goes so far as to claim to have detected in the person of Triptolemus, the mythical pioneer of agriculture among the Greeks, the authentic history of the first cyclist, and explains his reasons as follows;—A certain Roman writer, who was librarian to Augustus Cæsar, wrote a book on astronomy, in which he described Triptolemus as having been inspired by the goddess Ceres with the idea of extending the culture of corn in Greece. In order to enable him to travel rapidly from place to place, the goddess obligingly provided him with a single wheel, across which he used to stride.

At Stoke Pogis Church there is to be seen a window representing a man riding on what looks something like a modern safety cycle. The date of this window is 1640. This window, I believe, is known as the cyclist's window, but what the subject is intended to portray cannot be ascertained. The authenticated date of the first cycle seems to be in the year 1818 (but this date is quite modern compared with the notion of one American writer—viz., that the prophet Isaiah had his eye on the coming bicycle when he saw one wheel with one cherub and another wheel with another cherub), when the "Dandy horse" or "Hobby horse" seems to have been introduced into England by a certain Baron von Drais. It was exhibited by Dennis John, a coachmaker in Longacre, London, and styled by him a "Puedestrian Curricle," which, I presume, he thought a better name than the title given to it by the Germans, who called the machine a "Draisnene," after Von Drais, the inventor. The contrivance consisted of two iron-tyred wooden wheels about 30 inches in diameter, connected by a beam of wood, in the middle of which was a seat or saddle known as the "perch." Immediately in front of the perch was a rest or pad for the chest, and in front of this a kind of iron handle not unlike the handle found on an old bath chair, and by which the front wheel could be moved at will. The mode of propulsion was delightfully simple. Indeed, in so far as that one item "simplicity," the machine of to-day cannot hold a candle to it. When the rider had taken his seat his feet were just touching the ground. Leaning his chest against the support and firmly grasping the handles, he pushed the machine along by kicking the right and left foot alternately. When a certain amount of impetus had thus been acquired, the machine would proceed of its own accord, during which the rider

duration. When the momentum was exhausted he had to start again. From 1818 to 1830 the "Hobby horse" was a familiar object in the larger towns of Great Britain, and, indeed, enjoyed a fashionable popularity in the first years of its introduction. The young "bucks" of the upper ten took very kindly to the "Dandy," and were regularly to be seen taking their run in the park. Their attitudes were even too funny for that period, and the Dandy soon went out of fashion, helped considerably by the caricaturists of the day, who threw great ridicule on the invention. The professional funny men were, however, not the only enemies of the invention. The blacksmiths are stated to have taken every opportuuity of smashing the machines, which they considered did harm to the horse-shoeing trade. The next record of any improvement on the "Dandy horse" is between 1839-1840, when a Lanarkshire cooper, Gavin Dalzell of Lesmahagow by name, conceived the idea of making a machine which could be driven by cranks, and, stranger still, it was not to the hobby horse he fixed the cranks, but to a low rear-driven machine, the exact prototype of the present-day safety—a very different looking machine, needless to say, from the machine of to-day, but all the same a remarkably clever invention. In this contrivance the pedal movements, which moved backwards and forwards alternately, were connected by iron rods with the cranked axle of the driving wheel, which was constructed of wood shod with iron. The machine had a wooden frame, and very much the same kind of wheel as found on the "hobby horse." The fame of the "wooden horse" became widely known, and it is on record that a foreign inventor came forward to endeavour to prove the original idea was his own, and it is not unlikely that it was from Dalzell's machine that Pierre Lallement obtained his idea of fixing cranks to the front wheel of the hobby horse, and so producing what is known to this day as the "Boneshaker." Outside Lanarkshire, however, the invention seems to have been very quickly forgotten. At any rate the public did not take it up, and consequently it made no headway. About 1862 the attention of the public was again directed to cycling, although in the meantime many strange and wonderful devices had been brought to light, bearing equally strange and uncouth names, of which I may quote "manivelociters," "trivectors," and "allepodes" as specimens. At the 1862 Exhibition a firm, by the name of Messrs. Mahew, of

Chelsea, exhibited a tricycle essentially the same in design as the old-fashioned ones still to be found in some of our smaller towns and villages, where a little bodily torture is felt to be valuable as a chastening of the spirit. Still nothing came of the invention until, in 1867, Messrs. Michaux & Co., of Paris, introduced a machine invented by one of their workmen, Pierre Lallement by name, which seems to have been our old friend the hobby horse with cranks and pedals attached to the front wheel. This machine, like its forerunners, was made of wood, had iron tyres, and was quite innocent of springs. Notwithstanding this, however, it seems to have found favour with the public, who very rightly christened it the "Boneshaker." Boneshaking was confined to the comparatively wealthy for some time. The illustrated newspapers of 1867-1869 contain several woodcuts representing the Prince Imperial on his boneshaker in the Tuilleries. The sport was also taken up in gymnastic circles, one of the earliest of the machines made by Messrs. Michaux being introduced into Spencer's gymnasium in London in 1868 by a Mr. Turner, who brought one over from Paris. From this event may be said to date the advent of the bicycle as we know it at present. English manufacturers took the manufacture up, and laid down plant suitable for the purpose.

It may be news to my readers to learn that the Coventry Machinists Co. (now called the Swift Cycle Co.) was the first of the pioneering firms of the cycle industry. It may not be out of place to mention that the manufacture of cycles, which has made Coventry the town it is to-day, was introduced into that city in order to find employment for the large number of skilled operators who were thrown out of employment in consequence of the failure of the silk ribbon industry in 1859. The new treaty with France completely ruined the English silk trade, Coventry feeling its effect perhaps more than any other place, owing to the ribbon industry being the staple trade of the city. Owing to the severe competition of the French manufacturers a crisis took place, and many firms came to grief. Seeing the distress amongst the working classes several local gentlemen—some of whom are living to-day—combined together and cast about for some new trade which would give employment to the starving silk workers. Sewing machine making was thought of, and ultimately was chosen as the business to be cultivated. Three men whose names have come down to us were induced to come from Lewisham to

Their names were James Starley, Josiah Turner, and an American named Salisbury, all journeymen in the trade. Sufficient capital was secured, and a firm with the title of "The Coventry Sewing Machine Co." commenced operations. A good business appears to have been carried on, and the name of the "European" was given to the sewing machine, which became well known in all parts of Great Britain. After a time, however, the introduction of American sewing machines into this country and the consequent severe competition made it necessary that the firm should take up the manufacture of some other article, and the directors, with a very clear-sighted view of its future possibilities, took up the manufacture of cycles, which they have continued up to the present day. The title of the firm then became "The Coventry Machinists Co." The firm produced the wooden "boneshaker." Wooden wheels and frames gave way in time to steel, then solid metal frames gave way to hollow steel tubing, then the suspension frame enabled the strength to be retained but allowed considerable lessening in weight. For a long time the high front wheel "ordinary" bicycle ruled the roost, but in 1884 the safety frame, with a chain-driven driving wheel, made its appearance.

The cycle trade unquestionably owes much to the mechanical inventions of James Starley, who very soon commenced business as a cycle manufacturer on his own account. At his death the Coventry citizens erected a marble monument to his memory. From the Coventry Machinists' works several of the most inventive of the hands went forth to start businesses of their own. The cycle trade to-day is notable in this respect, that it was largely developed by skilled workmen in their own interests rather than by capitalist amateurs. Of course, vast sums have been put into businesses by outsiders, but, generally speaking, practical mechanics have always been at the head of the firms. There are to-day in Coventry many first-class firms whose founders were originally workmen in the Coventry Machinists Co.

In 1888 the pneumatic tyre was introduced, invented by Mr. Dunlop, a veterinary surgeon of Belfast, to combat the complaint his son made about the vibration when riding. Innumerable improvements have been made in cycle construction in the last few years, until at the present time we have now a cycle so beautifully built, so light, and at the same time so strong, that it is little short of marvellous the machines stand the strain and

rough usage they sometimes get. It is interesting to note that, although the French and Germans were the real introducers and manufacturers of the cycle, yet when the English manufacturers took the manufacture in hand they were soon able to produce an article much superior to their Continental rivals. Of late years very severe competition has been felt from our American cousins, but the English manufacturer is still able to hold his own and produce a machine very much ahead of the American article in point of construction and finish.

Prior to the boom in cycles in 1896-7, owing largely to ladies taking to the pastime, and the consequent enormous demand on both ladies' and gentlemen's machines, cycle factories proper were only found in Coventry, Birmingham, Nottingham, Wolverhampton, and a few other towns, and although to-day almost every town with any claim to importance has now its local manufacturers, yet the towns mentioned have still every claim to be considered the headquarters of the trade. The sudden demand for cycles caused many men in various towns in Great Britain to imagine that they had only to open a cycle factory in order to spring into affluence in a very short time, and it is to this class of manufacturer I opine that we have to look for our losses.

In the towns mentioned are to be found cycle factories which have been specially built for the trade, and which form really first-class risks. Cycle factories, however, differ very much, and you cannot take any one risk as being a guide as to what the risk is likely to be when a proposal is laid before you unaccompanied by a plan and report. You will find cycle manufacturing carried on in buildings which at one time were used for an entirely different purpose, but which, with suitable alterations and additions, meet the trade requirements of the cycle manufacturer very well, and also form very fair risks. Then we meet again the building which no amount of alteration will ever make suitable to the manufacture to be carried on, and it is in such risks that the Surveyor should pay the greatest attention to the various processes performed. These converted buildings have in some cases been used as ribbon factories, cotton mills, engineering works, etc., and previous to the sudden demand for cycles may have remained empty for some years. They are usually of some stories in height, and, owing to the heavy weight carried by the floors, and the internal communications from floor to floor, cause a heavy loss in case of a serious fire. In such risks the heavy metal-working

being left for the manufacture of the lighter parts and as warehouse for finished parts. With the greatest care, however, storied factories will always remain the worst risks, as experience has shown. If the building is not very substantially constructed the erection may collapse, and more damage be done from this cause than from actual damage by fire. The ideal cycle factory should be of shed construction, with overhead shafting, and having a concrete floor. The enamelling shop, finished warehouse, and gas engine or boiler house should be distinct. Lighted with electricity, and heated by low-pressure hot-water pipes or exhaust steam. Firms, however, doing large trades and having a large output per week find the land required would cost too much to rent or purchase, and consequently it is only in the minority that such shed factories find their place. I do not propose to take into account in this paper the small factory turning out about 20 machines per week at its busiest time. What I am about to describe is an established factory such as found in Coventry and Birmingham, etc., carrying on a good trade and turning out from 600 to 1000 machines a week when busy.

Trade Process. I can confidently state that there is not one cycle factory in the British Isles in which every component part of a cycle is manufactured. Such a factory does not exist at the present time. When I inform you that the following parts are usually purchased—viz., handle grips, pedals, balls, spokes, steel tubing, steel stampings, chains, foot rests, nuts and screws, tyres, rims, pumps, saddles, wallets, and spanners—I can imagine my reader exclaiming—"Well, what *do* they make, and how *can* they honestly use the title 'cycle manufacturer' when almost every part *is bought*?" In some of the larger firms the pedals, nuts, and screws are manufactured on the premises, but very seldom in the medium-sized risks. The parts actually manufactured are the frame, cranks, hubs, spindles, cones, chain wheels, handle bars, brake-work, wheels, mud-guards, and gear cases, although in many firms the two latter articles are also purchased. It may astonish many to learn that there are over 900 distinct parts in a cycle, and in a cycle fitted with the free wheel attachment nearly 1000. To watch an experienced workman fit the various parts together is very instructive, and seems very simple. I should like to warn

my readers, however, against attempting the feat (I cannot call it anything else) of taking his machine to pieces and putting it together again. I tried it once, and I should not have been greatly surprised to learn there were double this number of parts in the machine after I had finished.

Machine Shop. Almost the first process undertaken in a cycle factory is the machining of the cranks, spindles, chain wheels, hubs, etc. These parts are purchased from steel-stamping works, if stampings are used, and from special foundries undertaking this class of work, if castings are used. They come on to the premises in the rough, and a large amount of labour and trouble has to be expended on them before they are allowed to leave the machine shop and be passed into another department. In the machine shop we find machines for metal turning, milling, shaping, profiling, etc., and we are now meeting much more frequently than formerly the automatic machine upon which cups, screws, spindles, etc., are automatically manufactured from the solid steel bar. In this class of machine we generally find that a high speed is required, and in order to turn out the work properly, perfect lubrication must be observed. This is met with by having an automatic oiling arrangement in connection with the machine itself, and it will generally be found that there is a tank in the base of the machine holding 30 to 40 gallons of lard oil or lard, olive, and paraffin mixed, which is pumped up and poured directly over the tool, which may be for turning, screwing, or cutting off just as the case may be. It is usually found that the floors in the immediate vicinity of these automatic machines are saturated with oil, and care should be taken to see that some means are adopted to stop the floors from becoming entirely permeated. If the machines are standing on a brick, earthen, or concrete floor so much the better, but even then the floor should be kept scrupulously clean, and all waste and sawdust removed out of the shop regularly. The addition of mineral oil to the lard and olive oil very materially reduces liability to spontaneous combustion, but it is well to be on the safe side and guard against such a contingency by having a clean shop. If the automatic machine is standing on a wooden floor, the boards under and around same should be covered with sheet lead; if this cannot be done, sand should be laid around the machine in order that any oil thrown off may be easily absorbed.

proper, should be carefully inspected on account of the great heat usually required. Generally the muffle is away from the main building or in some shed building adjoining, but you will often come across a special kind of gas-heated muffle which consists of an iron box or compartment, lined with fire bricks, standing on iron legs some 4 feet high from the floor, and which has an air-pipe attachment supplied from a fan. This muffle is usually used for small work, and should stand quite clear of all woodwork, and if on a wooden floor the flooring around and underneath should be protected with sheet iron or some fireproof composition.

Smith's Shop. In this shop, which is generally of shed construction and has an earthen or brick floor, we find the usual smith's hearths, which may be constructed of brickwork or of iron. Attention should be given to the condition of the hearth, its flue pipe, and the hood over the fire. The weldless steel tubes, front forks, brake-work parts, etc., are bent or hammered in this shop to their required shapes. When a hollow tube is about to be bent out of the straight, take for instance a piece of tubing intended for the handle bar, some plastic substance must be packed into the tube to prevent buckling. Most firms fill the hollow tube with molten lead, which is recovered after the bending operation has been performed, others use sand, and some a mixture which contains a good proportion of beeswax. Care should be taken to see that the lead-melting furnace is in good condition, and if gas heated, the connections should have every attention.

Frame Building. The next process we come to is the cycle frame building. I have already explained that the steel tubes are purchased from the tube mills. They come on to the cycle factory premises in long lengths, and are cut up into shorter lengths as required. The tubes then pass into the hands of the frame builder, who fits the lengths of tube into the various lugs, pegs same together with metal pegs, and passes on to the brazing shop.

Brazing Shop. The brazing of the joints of a cycle frame is almost always done by gas and with the blowpipe. The brazing hearths are generally constructed entirely of iron, and the pan stands on iron legs some 4 ft. from the floor. The pan holding the "breeze" or small coke should be of wrought iron to prevent cracking. In the smaller factories we find the brazing hearths have a foot bellows attached, but in the larger factories there is generally a distinct system of air pipes running in close proximity to the gas pipes, supplied by a blower or fan, the size of which depends on the number of fires to be blown, and driven by a belt from the main shafting. The blowpipe is connected on to both the air pipe and the gas supply by stout rubber tubing, which is always rendered safer by being armoured. For my own part I prefer to see flexible metallic tubing in use, and always recommend same to our Assureds. The air enters the pipe behind the gas supply and thus forces out the gas in front of it, the supply of both air and gas being regulated by the man performing the brazing operation in proportion to the size of the brazing to be done. The joints are soldered with brass, and borax is used as a flux. Attention should be paid to the condition of the indiarubber tubing supplying the gas, as it is very liable to perish when exposed to heat, and cracks are bound to take place in the tubing in the course of time. When the gas supply pipe is found to be in a worn condition it should be at once condemned, and a new tube substituted. The blowpipe when not in use should be hung on a peg as far away from the hearth as possible. It should also be the duty of the foreman of the brazing shop to see that the gas is properly turned off each blowpipe every time the hands cease work, and, if possible, the gas supply should be cut off entirely from the shop each night before closing. A few firms immerse the joints of the frame in a bath of molten brass, which they contend gives a more satisfactory result. Where this system of brazing is adopted the hearth is generally constructed entirely of iron, and has a coke fire, on which is a forced draught, under the receptacle containing the molten metal. It is needless to mention that this kind of hearth should always stand on a brick or earthen floor. After brazing, the frame is taken to be sand-blasted. This process is similar to the sand-blasting in glass works, and removes the scale and roughnesses from the tubes; then the frames are filed up by hand, the joints being made as smooth as possible. The frame is then set perfectly true and

together in their unfinished or rather unpolished and unplated state, or, as it is termed in the trade, "assembled in the grey." After the machine has been carefully gone over and every part made to fit perfectly together, it is taken to pieces again, and the frame passed on to the enamelling shop, whilst the bright parts go to the polishing and plating shops. In the polishing shop we find the polishing spindles at each end of which are the polishing bobs running at a high speed, something like 2000 revolutions a minute. The bobs are made of circular blocks of wood with leather covered edges, which are painted over with glue and then passed through a box of emery dust.

The term polishing, in the cycle trade, means the polishing of any component part previous to electro-plating. The polishing after electro-plating is termed "mopping," and for which a much softer bob is required. The mopping bob is made of several circular pieces of calico fastened through the centre only, but which has every appearance of a solid wheel when running owing to the high speed obtained. The polishing is done with crocus (a non-hazardous composition) and also with Sheffield lime. The benches should be zinc covered, and great cleanliness should be observed in this department, the liability of Sheffield lime to spontaneous combustion under certain conditions being well known. Any stock of Sheffield lime should always be kept in a metal receptacle, and placed on a flag if in a room having a wooden floor. No accumulations of used lime should on any account be allowed. The position of the gas ring over which the glue kettle is heated should also be taken into account.

Electro-Plating Shop.

In the electro-plating shop we find the usual dynamo required in the process, and which may generally be considered as adding little if anything to the risk of fire. A very low voltage with a high amperage is requisite if a good result is to be obtained, and consequently the risk of ignition is very slight. The resistances, however, should always be on a slate base. In this shop we find the usual baths—one generally for primarily putting on a deposit of copper, and then the nickelling baths. The hot-water tanks and sawdust drying-out pans are usually steam-heated, but occasionally they are found to be heated by gas rings placed underneath. When this is found to be the practice,

care must be taken to see that the floor underneath (if of woodwork) is properly protected. After the parts have been properly plated, they again go to the polishing shop and are mopped or dry-polished, which gives a very brilliant surface to the nickel coating.

Enamelling Shop. In this department the cycle frame to be enamelled is first of all sweated in a stove at a temperature of about 350 degrees, then taken out and cleaned with emery and turpentine, and finally polished with dry emery only.

The frame is dipped into a tank of enamel, suspended on hooks to drain, dried in the stoves, taken out and rubbed down with pumice stone to get out any rough surfaces, dipped into a tank containing a lighter consistency of enamel, and again stoved. The gold or coloured lining on the frame is usually done in this department, and the transfers or trade-marks are also affixed. In high-grade machines several coats of enamel are given to the frame, and after each coating it is necessary to stove same.

It is always better to have the enamelling stoves out of the main building, but if such a course is impossible, then the shop should be made as secure as possible by having the flooring covered with some incombustible material and seeing that the stoves are placed upon a substantial quarry or brick foundation. The stoves are generally found to be constructed of iron, although occasionally brick compartments are to be met with in some factories. Some iron stoves are doubly cased throughout, and have the bodies made of 14-gauge metal bound by 3-16ths with double doors; others are only made of single sheet. Both kinds are heated with several rows of gas jets on the Bunsen burner principle, placed horizontally about six inches from the floor, and in some stoves the gas pipes are placed around the stove instead of across. The stoves are heated up to 280 to 300 degrees Fahr., and proper fume pipes should be provided. Care should be taken to see that the top of the stove and the fume pipe are well away from combustible material, and that nothing is ever placed or thrown on to the top of the stoves, as it is here that the greatest heat is found, owing to the gas jets driving the heat upwards. The cycle frames are suspended on hooks from the top of the stove, and remain therein about two to three hours.

The enamel used generally consists of two parts of Pontypool varnish to one part of black tar varnish, thinned as required with

ferent quantities in the making up of their enamel, but the substances I have mentioned will always be found to form the base of the preparation. The storage of any of the liquids in bulk in the enamelling shop should not be allowed. In the enamelling shop as in the brazing shop, a distinct cut-off tap on the gas supply should be provided, in order that the supply can be shut off this particular department each night. All cloths and wipes should be regularly removed and burned. If the enamelling stoves are properly fitted and a high state of cleanliness prevails, the enamelling shop is not the dangerous place it would appear to be The enamel is not dangerous unless it is of a very cheap, inferior kind and contains a high proportion of common spirit. If the enamel is bought ready mixed, it is as well to enquire the price paid and compare this with other prices paid by firms doing high-class work only. The transfer or trade-mark is fixed by giving the portion of the frame chosen in which to place the trade-mark a light coating of copal varnish, over which is placed the paper transfer, which is allowed to dry, then washed off with water.

Some firms make their own metal gear cases, and where this is found to be the case enquiries should be made as to whether the gear-case stove is left burning throughout the night. Owing to the presence of solder in the joints of the gear case, a much lower temperature is necessary in the enamelling process, with a consequent longer stoving. If the ordinary temperature was used the solder would run and the gear case be spoilt.

Wheel-Building. The wheel-building shop is a department quite to itself. Here the iron rims are drilled and the spokes laced from the hub and fastened on to the rim. There is no process in this department which adds in any way to the fire risk. After the wheel is trued up it is either passed into stock or sent into the finishing department to be built into a cycle immediately. In some cases the tyre is also attached in this room, but as no solution is now required to fix on a tyre there is little risk in this operation.

Final Finishing. We now come to the final process in the manufacture of the cycle, and it is in this shop that the finished, enamelled, and plated parts are assembled and put together into a finished machine. Here every

part is made to fit accurately, and any little alteration required is carried out on the spot. The handle grips are fastened on to the handle bar with a composition known in the trade as "pack-wack," and which is a substance not unlike cobbler's wax, but containing much more guttapercha. The handle bar is slightly heated over the gas, and the pack-wack or handle cement rubbed over same, after which the grip is pressed into its position. Pack-wack is not a dangerous substance, and does not easily light when held over the gas flame. The gear cases, mud and dress guards, are also fitted on in this department, and where celluloid gear cases and mud guards are made a speciality, due regard should be had to the highly inflammable nature of the substance, and the possibility of contact with naked lights guarded against. I have several times heard of cycles being sent back to their makers to be re-enamelled, and have new tyres and gear cases fixed, owing to their owners having accidentally dropped lighted matches on to the celluloid gear cases when lighting their lamps at night. (*See* Appendix A.)

Works Stores. In this portion of the premises we find all the articles which are likely to be required in any part of the factory in the construction of a cycle. The pneumatic tyres which may be stocked generally have a room allotted to themselves. The cycle firms nowadays do not stock any large quantity of tyres, owing to the fact that the tyre manufacturers are in closer touch with their customers, and can supply on very short notice. Cycle manufacturers do not care to carry a large stock of tyres owing to their liability to perish under certain conditions if not well looked after.

Indiarubber Solution. About half a dozen cans of solution in 1 lb. cans may be kept for use in the repairs shop, but this cannot be considered as adding much to the fire hazard if the most ordinary care is taken.

Where the rough and finished parts are stored, we generally find a large amount of wooden shelving divided off into small compartments erected against the brick wall, and very often there is a similar timber erection running down the centre of the room in addition. In these compartments the various parts of a machine are stored, and care should be taken to see that all gas brackets are of the fixed pattern; if movable they should be altered.

Sheffield Lime. If this is kept in bulk, particular attention should be paid to the manner in which it is kept. It should be stored in a metal drum with a proper cover, and a metal scoop should be provided. It should also be kept in a dry place.

Calcium Carbide. Occasionally you may find a few pounds of calcium carbide kept for the use of some of the officials or for the convenience of customers who may happen to call at the works. It is generally kept in hermetically sealed tin canisters holding about 1 lb. in each, and not more than half a dozen pound cans should be allowed. Calcium carbide is quite harmless if kept in a dry place, but if brought into contact with moisture it generates acetylene gas. In actual contact with water it evolves torrents of acetylene, producing roughly 5 cubic feet of gas for each 1 lb. of calcium carbide. The percentage of acetylene necessary in the atmosphere of a room to bring about an explosive mixture is also much lower than ordinary coal gas, and consequently acetylene gas is all the more likely to cause an explosion if any unperceived generation takes place through careless storage.

Petrol and Motor Cycles. Many cycle firms are now manufacturing motor cycles in addition to their ordinary trade, and almost all firms extending in this direction have some kind of experimenting room. In this room the motor machinery is tested, and about a quart of petrol will be found in the tank on the testing frame. This experimenting should always be carried on outside the main risk if possible, but on no account should a larger quantity of petrol be allowed than is found in the reservoir of the motor. Petrol is only another name for highly refined petroleum, which evaporates very rapidly when exposed to the atmosphere. The fumes are very inflammable. I came across an instance about 10 days ago where fire was communicated, although the nearest gas light was some 20 feet away, from an uncorked can of petrol which had been placed on the floor by a workman doing repairs to a motor car.

Gear Case Shop. There is little to call the attention of the Surveyor to here beyond the fixing of the tinmen's bench stoves, and an enquiry as to whether celluloid cases are made or put together, which is very rarely the

case, as they are usually purchased in various sizes from the gear case manufacturers themselves.

Gas Engine House. Most cycle factories are driven by gas power, and it is always very necessary to see that the exhaust box and pipe are well away from combustible material, and that the gas bag is protected. Where steam power is used I need not point out to you the necessity of paying attention to the position of the boiler and its flues and firing place, and also the position of the live steam pipe to the engine, all of which ought to be quite clear of woodwork.

Repair Shop. One part of the factory is generally set apart for repairs to damaged cycles which are received by the firm from time to time, but the operations in this room do not extend outside the various processes already described. Repairs to tyres are sometimes carried on, and this necessitates the use of indiarubber solution, and occasionally a little naphtha. Perhaps a small bottle of naphtha may be kept in the room, but an enquiry should always be made to ascertain the quantity, if any kept. Cycle manufacturers proper, however, do not care for tyre repairs if the damage is extensive, and the tyre is sent to the tyre manufacturer for attention in many cases.

Wrapping-up and Despatch Room. In this room cycles to be sent away are wrapped round with either calico or paper strips, the bright parts receiving a coating of vaseline to prevent rust. In the majority of cases the wood frames or crates in which the machines are placed are nailed together from wood strip which is sawn up into the required length by hand. This amount of woodworking is generally not of sufficient magnitude to be seriously taken into consideration, but I have seen several factories where the crates have been manufacfactured throughout and working in wood carried on to such an extent as to add materially to the risk. Needless to say, where such a state of things is found to exist endeavours should be made to have the woodworking removed to a distinct building.

Pattern Shop. You will generally find some small room in the factory which is devoted to the making of wood patterns which become necessary when a change in the style of some component part is contemplated. The pat-

can be passed over by the Surveyor, who will of course give the usual attention to the condition in which this shop is found.

We have now gone into all the processes found in a cycle factory, and which doubtless has helped you to form some idea of the trade risk incurred. I have drawn your attention to the special risks in connection with the various processes as we have proceeded, but, as already pointed out, it is very unwise to form any opinion of a particular risk until you have before you the plan and report of the premises or have visited the factory yourself. An experienced manufacturer arranges his factory to suit the trade requirements, and knows from actual experience that certain dangers attach to particular operations, against which he protects himself from the risk of fire wherever possible. You can judge from the order and cleanliness prevailing in a factory whether same is under good management or not, and I regard this point as one of the principal questions to be borne in mind when a proposal is being considered. A point which has been occupying the minds of both head office and branch officials of late is that of the moral hazard attaching to a cycle factory acceptance. It is common knowledge that the business is in a very depressed condition at the present time, and where this state of affairs exists in any particular trade, experience has shown us that fires are likely to happen—not actually connived at, but assisted very materially by the low state of order and cleanliness in which the premises are allowed to get from want of attention. It is unfortunately a fact also that the cycle trade flotations of two or three years back were based upon the most extravagant estimates of profit-earning powers. In many cases the flotations were arranged by unscrupulous outside promoters, who always come to the fore when a trade is booming. From the list I have before me, which was compiled by one of the ablest accountants in the cycle trade in March last, you will see that it is well-nigh impossible for many of the companies to make a profit on their present capital. (*See* Appendix B.)

It may astonish some to know that instead of the demand for cycles decreasing, it is actually increasing, the number of machines sent out of the factories last year exceeding all other outputs. Every year adds to the number of riders, and every year brings the youth to the age when he finds a cycle almost a necessity. The supply, however, exceeds the demand, and many firms will

have to be liquidated and reconstructed before the trade goes into a healthy condition again. The question naturally arises, "Would a fire help such a firm to recover themselves?" and of course it is a point to be seriously considered. I do not think, in the case of a limited liability company, you have much to fear on this score, and in proof of my contention I may mention the following firms who have quietly ceased to exist and been liquidated without the fire policy being brought in as an asset:—

Coventry Cross Cycle Co.,
Elswick Cycle Co.,
Ormond Cycle Co.,
New Beeston Cycle Co.,
Bard Cycle Co.,
Trent Cycle Co.,
Brookes Cycle Co.,
Starley & Westwood Cycle Co.,

and several others I could mention. I question very much if any one official is sufficiently interested financially to benefit by a severe fire taking place. Officials of public companies cling to their positions very tenaciously, and as a bad fire would most likely terminate their engagement, their endeavours would, I am sure, be devoted to keeping the concern going as long as possible. A few years back, when the pattern of the cycle was changing almost every six months, a manufacturer might occasionally have been caught with a stock in hand which had gone out of date, but even then we did not hear of the frequent fires which might have been expected. The present pattern of cycles seems to admit of very little improvement—at any rate, little or no change has taken place for the last three years, so that a better market can still be found for an up-to-date stock than would be obtained from a loss assessor who knew what he was about. We must not assume that the trade is entirely of a mushroom character; there are many firms in existence to-day whose moral character is beyond reproach, and who have been in business, trading with more or less amount of success, for the last twenty years, amongst whom I may mention the

Singer Cycle Co.,
Centaur Cycle Co.,
Humber Cycle Co.,

Riley Cycle Co.,
Quadrant Cycle Co.,
Rover Cycle Co.,
Townend Cycle Co.,
Rudge-Whitworth Cycle Co.,
Raglan Cycle Co.,
Premier Cycle Co.,
Swift Cycle Co. (formerly Coventry Machinists Co.),
Raleigh Cycle Co.,
Star Cycle Co.

With regard to the question of rating, it is very questionable if cycle works acceptances have paid the Offices. A very fair income from this particular industry must now be annually paid in premiums, but we have sustained some nasty fires, which have taken large sums of money to settle, notably the

Humber Cycle Co., Coventry
(Supposed to have been caused from a pile of wooden crates in the yard catching fire, and not from any inside source),

Mutual Cycle Co., Leicester,
Elswick Cycle Co., Newcastle,

and several fires costing from £200 to £1000 each, of which very little has been heard. Prior to the fire at the Humber Co.'s factory in Coventry, cycle factories were freely accepted in this district at a rate of 2s. 6d. per cent., but it seems to be generally admitted that 5s. per cent. is now nearer the mark for storied factories and 3s. 6d. per cent. for shed factories. Whether the industry has become one of sufficient importance and magnitude to warrant the attention of the Tariff Offices Committee I am not in a position to say. Certainly it seems very unfair to make one uniform rate for all risks, irrespective of the peculiar and hazardous points found in some factories. Everything depends on the ability of the Surveyor to appreciate the risk before him, and on the enquiries which should be made into the history of the firm. If these means are adopted, the bad fire risks and financially shady firms of a doubtful moral character will be eliminated, and I fail to see why a profitable business with well-established respectable firms should not be done by the Offices. I have now

exhausted my subject, and if I have been successful in interesting you in "Cycle Factories from a Fire Underwriter's point of view" I shall feel that my endeavours have not been altogether unrewarded.

A. E. PATRICK.

Birmingham Insurance Institute,
December 14*th*, 1900.

Danger of Celluloid.

Professor Th. Petersen was asked by the Insurance Company which had to pay the damages caused by the fire at the Adler Cycle Works, in Frankfurt, to give an opinion if the fire was not caused through storing large quantities of celluloid goods without protection. Professor Petersen is an expert on such questions, and his report is of interest to all dealing with this highly inflammable material. Celluloid, Petersen says, is a mixture of pyroxylin and camphor—two-thirds of the former and one-third of the latter—which are mixed by a special process and prepared under a low heat. Pyroxylin, or nitro-cellulose, explodes when striking it under a low heat; at 140 degrees it begins to decompose when brought in contact with nitric steam, and when the heat reaches from 220, 300, or 360 degrees it dissolves without assistance. When this material is mixed with camphor it loses the aforementioned qualities, and makes the so-called celluloid. When celluloid is brought under great heat it dissolves, and leaves a yellow, evil-smelling smoke. In contact with nitric steam, it dissolves as it works together with the camphor. An open flame, or only a match, ignites celluloid, producing a red glimmer. Even when smouldering it develops steam and soot. When celluloid does dissolve itself under influence of great heat cannot be exactly fixed, as the colour contents in most mixtures differ in their imperviousness against burning, but generally from 250 to 280 degrees can be taken as the average. The celluloid store-room of the Adler Works was a room 80 by 50 by 10 feet on the fifth floor of the store-house, the ceiling and floor being cemented. Two heaps of gear-cases, amounting to 400, were in store, and these ignited, causing the conflagration. Four hundred gear-cases are a large quantity of celluloid. The testing of the steam-heating apparatus may have brought a heating pipe in close contact with gear-cases, or one of the cases must have been old, when it often happens that rust developing acids which tinge the otherwise clear celluloid, and such acids can also be the cause of celluloid ignition. That Insurance Offices should be careful in accepting store-rooms containing celluloid goods is, therefore, the necessary conclusion. — *The Cycle Trader*, 15*th February*, 1901

APPEN-

CYCLE COMPANIES

No.	Company's Name.	Accounts made up to	Capital Employed.			Total Nett Profits on Share Capital.		Percentage on Share Capital.	
			Debentures Issued.	Shares Issued.	Total.	Profits.	Losses.	Profits.	Losses.
			£	£	£	£	£	*Per cent.*	*Per cent.*
1	Abingdon Works -	Aug. 31	—	60,400	60,400	3,453	—	5·71	—
2	Bard Cycle - -	—	—	—	—	—	—	—	—
3	Bayliss-Thomas -	Sep. 30	7,500	64,900	72,400	—	3,547	—	5·46
4	Buckingham & Adams*	Aug. 31	10,285	16,375	26,660	—	426	—	2·60
5	Calcott Bros. -	,,	10,000	45,007	55,007	—	2,908	—	6·46
6	Enfield - -	,,	—	124,962	124,962	7,583	—	6·06	—
7	Humber - -	,,	—	477,084	477,084	8,337	—	1·74	—
8	James - - -	—	—	—	—	—	—	—	—
9	New Centaur -	July 31	—	124,875	124,875	—	2,168	—	1·73
10	New Coventry Cross	Aug. 31	26,220	40,482	66,702	† 291	—	0·71	—
11	New Hudson -	,,	—	58,033	58,033	6,011	—	10·35	—
12	New Rapid - -	,,	17,700	129,148	146,848	—	4,305	—	3·33
13	New Townend -	Sep. 30	—	80,000	80,000	—	3,948	—	4·93
14	New Premier -	Aug. 31	100,000	600,000	700,000	—	7,595	—	1·26
15	Osmond - -	Sep. 30	*a* 6,350	188,068	194,418	—	*b* 19,997	10·63	—
16	Progress - -	,,	—	49,500	49,500	90	—	0·18	—
17	Quadrant - -	July 31	—	51,362	51,362	—	2,641	—	5·14
18	Raglan - -	Aug. 22	50,000	120,000	170,000	4,482	—	3·73	—
19	Raleigh - -	Aug. 11	33,320	93,855	127,175	11,631	—	12·39	—
20	Riley - - -	Aug. 31	5,500	31,000	36,500	—	1,506	—	4·85
21	Rover - - -	,,	50,000	150,000	200,000	7,304	—	4·86	—
22	Rudge-Whitworth	,,	16,500	174,426	190,926	17,615	—	10·09	—
23	Star - - -	Sep. 30	—	120,000	120,000	5,472	—	4·56	—
24	Singer - - -	,,	200,000	600,000	800,000	3,026	—	0·50	—
25	Swift - - -	Aug. 31	75,000	300,000	375,000	5,139	—	1·71	—
26	Triumph - -	Sep. 30	40,000	130,000	170,000	5,506	—	4·23	—
27	Wearwell - -	,,	—	30,000	30,000	3,331	—	11·10	—

Dividends Paid.		Amount of Goodwill, Patents, and Preliminary Expenses.	Nett Assets after deducting Debentures, Debts owing, and Goodwill.	Percentage of Nett Assets to Share Capital.	
Pref.	Ord.				
Per cent.	*Per cent.*	£	£	*Per cent.*	
6	6	17,500	53,548	88·65	Profit subject to further deduction for Managing Director's commission and other contingencies.
—	—	—	—	—	
Nil.	Nil.	27,279	35,695	55·00	
Nil.	Nil.	5,000	10,949	66·86	*For nine months.
Nil.	Nil.	Not stated.	—	—	Goodwill excessive.
7	5	57,002	84,892	67·93	
Nil.	Nil.	Not stated.	—	—	Goodwill excessive. No reserve made for amount owing by John Griffiths Cycle Corporation in liquidation.
—	—	—	—	—	
6	Nil.	53,153	75,065	60·11	
Nil.	Nil.	18,397	22,375	55·27	†For nine months nothing written off formation expenses, £786 15s.
6	5	1,664	63,230	108·95	No provision made for investment in another Company's shares.
Nil.	Nil.	100,258	7,862	6·08	
Nil.	Nil.	26,166	52,992	66·24	
3	Nil.	Not stated.	—	—	Goodwill excessive.
Nil.	Nil.	Not stated.	—	—	(*a*) In addition, there are First Debentures to the value of £30,000 issued to the Bank as collateral security against the overdraft of £16,516 12s.
Nil.	Nil.	23,000	26,703	53·94	(*b*) Represents losses for two years. Accounts not furnished or published 1899.
Nil.	Nil.	21,266	30,167	58·73	Nothing allowed for depreciation.
—	3	81,633	66,066	55·05	
—	10	24,031	93,118	99·21	No dividend paid on Deferred Ordinary shares.
Nil.	Nil.	17,000	16,935	54·62	
—	5	124,205	49,752	33·17	
6	10	56,306	174,426	100·	
7	Nil.	86,839	42,666	35·55	
3	Nil.	574,752	32,805	5·46	
5	Nil.	Not stated.	—	—	
5	Nil.	80,300	57,593	44·30	
6	7½	16,500	20,570	68·56	

GLYCOSURIA AND LIFE ASSURANCE.

THE subject of my short address has been chosen, not because its importance has been entirely overlooked by those most interested in Life Assurance, but rather because I have had so many cases of glycosuria under notice within the last few years that I am struck with the very great questions which may, and which ought to, arise in the matter of acceptance or rejection of such cases by Life Assurance Companies.

I remember when few of us, comparatively speaking, insured our lives. Now we seem to live in an age of assurance. At one time Life Assurance was almost confined to the rich. Now it is universal amongst the poor. By buying a paper at a railway station one can assure against accident. The thrifty housewife by trading with one shop insures her husband's life for a substantial amount, and by paying a moderate premium any healthy person can provide for a sum to be paid over at death to the representatives.

Enormous businesses have been brought into existence, and the advertised capital of some of the enterprises only corroborates what I say.

Now, if this is so, it is evident that many bad lives must come under the notice of the medical advisers, and a great responsibility rests with them. Some of us may have earned a reputation for being too particular, but without a careful medical examination disasters must overtake Insurance Companies, and a Company without a doctor could not exist.

I am aware that a suggestion has been put forward to start such an undertaking, but to us it is obvious that this would only prove a haven of rest for the sick, a home for the decrepit, and a sanctuary for the dying.

If a medical examination is necessary it should be thorough, and those of us who are medical advisers should be careful to guard against passing unhealthy lives, whilst we should not jump too readily to conclusions and condemn a life because some abnormal symptom is present at the time of examination.

avoid technicalities, and state as simply as I can my views on the subject of glycosuria as affecting Life Assurance.

What is meant by glycosuria? The accepted meaning is sugar in the urine, and this condition is usually associated with the disease known as diabetes.

I may at once state that I look with suspicion upon all lives where I find sugar present. I do not absolutely reject, it is true, but I always recommend delay and a further examination in three months if no other diabetic symptom is present.

Sugar in the urine does not necessarily mean diabetes as medically understood, and therefore unless some other symptom of this disease is present I advise delay and not rejection. We have glycosuria without diabetes, but we never have diabetes without glycosuria.

I shall not here discuss the various theories of the pathology of glycosuria. Certain it is we have many varieties of this disease, and that treatment goes far to prolong life if not actually to cure. For Assurance purposes I shall classify glycosuria into two divisions:—

1. Glycosuria with other diabetic symptoms.
2. Glycosuria with no other diabetic symptom.

I make this division because I take it for granted that no Office would accept a life which presented symptoms of diabetes. It is true that some diabetics live long and enjoy fairly good health. So long as the diabetes is of what Dr. Pavy calls the "alimentary" form, *i.e.*, that form in which the carbo-hydrate matter of the food finds its way, in the form of sugar, into the urine, caused by a faulty assimilative power, no immediate destruction to life need be anticipated.

On the other hand, if the diabetes is of the "composite" form, *i.e.*, where the sugar is derived not only from the carbo-hydrates of the food but also from a morbid destruction of tissue, immediate danger is present. You will thus see that although I have divided glycosuria into two classes, the first is not of much interest to us, from the fact that the life is not insurable. It is round Class 2 that our interest centres—simple, not diabetic, glycosuria. These cases, although not eligible at time of examination, might ultimately prove good investments for the Office.

Simple Glycosuria. tion which are practically healthy, and only the tell-tale testing reveals that sugar is present. In normal conditions the urine is not affected by the food considered in connection with the carbo-hydrate matter.

Non-diabetic Glycosuria has been variously classified by different authorities. At the beginning of this year, Professor Saundby, of Birmingham, delivered a lecture on this subject and attempted very successfully to define the various forms of this disease. He divided these into—The Alimentary. The Pathological. The Alcoholic. The Hepatic. The Gastric. The Neuræsthenic. The Senile.

These divisions, from a medical point of view, are interesting, and I believe fairly exact, but to us to-night such a minute splitting up is unnecessary. The commonest forms of glycosuria, in my experience, are the alcoholic and hepatic, and I expect in many cases these are synonymous terms.

It is a curious fact, which has now been established, that a given quantity of sugar which in health will not produce glycosuria will provoke this symptom if the vena portæ is ligatured.

For the benefit of my non-medical friends I will describe the vena portæ as the portal system of veins which conveys the blood from the viscera of digestion. This portal vein enters the liver and divides into small branches in its substance. These branches emerge from the liver again and are called hepatic veins, which empty themselves into the inferior vena cava, which is the large vein returning to the heart the blood from all the lower parts of the body.

If, as I have stated, this portal system in interfered with, sugar appears in the urine. That is to say, that if some normal function of the digestive organs—the stomach—the bowels—the pancreas—the spleen, or the liver itself is disturbed, glycosuria may appear. It is also a fact that in various diseases not in any way connected with diabetes we find glycosuria. The urine of children suffering from whooping-cough frequently shows traces of sugar—also in those suffering from asthma, epilepsy, diphtheria or typhoid fever, may we find sugar.

From this I draw a deduction when I find sugar present, and feel certain that some disordered function has to be kept in mind, and that however desirable the life may otherwise be we should advise delay.

It is certain that some affections of the liver will act in exactly

the same manner as a ligature, and in alcoholics, whose livers are frequently faulty, we often find sugar. It has been found by experiment that by giving a patient suffering from a cirrhotic liver a large dose (6 to 8 ounces) of simple syrup, sugar could be produced in the urine.

Case 1. A gentleman, holding a very high social position, aged 34, was examined by me somewhat recently for a well-known Office. This life had been accepted by this Office three months previously and the proposal was an addition to the sum formerly insured. He was a remarkably well-made man, measured over six feet and weighed twelve stone ten pounds, and was very powerful. The whole history pointed to longevity. He had not had a day's illness for years, was of most active habits and fond of all sports. On examination every organ appeared normal, but on testing the urine with Fehling's solution a marked brown colour appeared. The sp. gr. was 1028. I requested that another sample should be tested in eight days. This was done, and again the examination revealed a like condition, and accordingly I recommended that the proposer should be seen again in three months. This proposer, you will see, presented no symptoms of diabetes, and I have heard since that he is in excellent health. I have no doubt he was astonished to find that his proposal was postponed.

Now I happen to know that this gentleman lives well, and to the liver I would attribute the glycosuria.

Case 2. This is an interesting case, which came under my care in the Lincoln County Hospital recently. A man, aged 32, was admitted complaining of pain in his side, with swelling of his legs. On examination, we found the whole of the superficial veins of the lower half of the body congested. There was marked tenderness just below the liver and evident obstruction to the return of blood from the lower half of the body. The inferior vena cava was certainly obstructed, and probably the portal vein also shared in this. No sugar was present in the urine. I gave this patient four ounces of simple syrup at 9 a.m., and again at 4 p.m., and at 9 p.m. tested the urine, when I found decided traces of sugar. This same amount of syrup given to another patient, with no sign of obstruction to the venous return, produced no glycosuria.

not in sufficient quantity to be detected by the ordinary tests. Dr. Saundby thinks that it is possible to produce sugar in the urine of all healthy persons by administering a sufficient dose of grape sugar—this varying from 300 to 500 grams of syrup of grape sugar. Without giving such large doses it appears to me that in certain individuals sugar very readily appears and that a comparatively small amount will produce glycosuria.

Case 3. A young man, aged 16, was sent to me complaining of weakness. He was slightly built, somewhat anæmic; the physical signs were normal. The urine was loaded with sugar. He admitted to being very fond of sweet things. He was dieted, and in a few days the sugar disappeared. He again ate ordinary food, and again the glycosuria returned. Now he diets carefully, although not very strictly, and there is freedom from sugar. He has gained weight and feels quite well.

Case 4. A professional gentleman, aged 32, was examined by me for assurance a year ago. He was pale and ill-nourished and of a highly nervous temperament. He had suffered from severe indigestion for some years and admitted that he was still in the habit of washing out his stomach at intervals. The various organs were apparently healthy and only on testing for sugar could I find anything wrong. There was a distinct trace present. A sample, a week afterwards, was the same. On enquiry from this patient's own medical attendant I learned that sugar was known to be present at intervals. This life I did not naturally pass, and yet I understand that he is now enjoying better health and able to do a hard day's work. This gentleman, I have no hesitation in saying, has not diabetes. He has none of the other symptoms so characteristic of this disease and yet has sugar appearing in his urine at frequent intervals. His case we should class as one of Gastric Glycosuria, but as the sugar is persistent in returning it would be unwise to accept his proposal.

In all these cases which I have brought before you we have examples of intermittent glycosuria. In some you will notice that sugar appears, if anything like excess of carbo-hydrates is taken. In some the suger appears without any apparent error in diet, and it behoves all medical advisers to carefully consider such cases before coming to a definite conclusion regarding them.

Risking repetition I again express the opinion that no case of glycosuria should be accepted at once; and only after careful consideration and future examination—say after three months—should it be thought of, and if the urine is then free from sugar, and the proposer is in good health, acceptance of the proposal might be recommended.

Before ending these somewhat disjointed remarks I would like to point out that errors in testing are liable to crop up. The method proposed by Sir William Roberts and carried out by Professor Saundby will be found for all practical purposes sufficient. If a urine shows reduction by Fehling's solution—this solution having previously been proved correct—we may be almost certain that we have sugar to deal with. But there are other substances which will reduce the copper. Chloral, salicylic acid, and chloroform all cause a precipitate of the sub-oxide of copper. But if we filter the urine—as suggested by Sir William Roberts—repeatedly through animal charcoal we will remove all the other reducing agents, leaving only the sugar. Dr. Saundby says he has followed this plan for the last two or three years and is quite satisfied with it.

Gentlemen, I fear my remarks have been *too* medical: but the subject chosen is so entirely one of medicine that to treat it otherwise was almost impossible. I hope I have proved the importance of the question, and perhaps I have also shown you that to examine a life is no sinecure for the doctor, and that although he may sometimes earn his guinea easily, there are many cases which give him anxiety and which place him in a difficult position, where a wrong diagnosis would not only prove unfortunate for the Office for which he examines but be a lasting disgrace to himself.

J. STITT THOMSON,
M.D., F.R.C.P.E., F.R.C.S.E.,
Hon. Physician Lincoln County Hospital.

Nottingham Insurance Institute,
1900.

LIFE ANNUITIES.

THE subject upon which it is my privilege to address you is one of peculiar width and variety of interest, involving in its technical aspect the consideration of the very elements of actuarial science, and in its historical and commercial aspect a survey of transactions extending over the greater part of three centuries, and including many instructive examples of State finance. The needs of those, however, who are interested in annuities in the theoretical sense, as a branch of actuarial science are abundantly satisfied in the text-books of the science, and the brief special reference to this branch of the subject which it has been found desirable to make in the present paper may conveniently be dealt with in the form of an Appendix. In the main portion of the paper I propose to lay before you some notes upon the historical features of the subject, with occasional reference to some of its practical considerations, and trust that in so doing I may be enabled to interest you, and especially those of your body who are concerned in Life Assurance work, and who may, perchance have speculated upon the chances which have brought annuities into their present apparently anomalous position—cultivated by the Government in the redemption operations of the National Debt, but avoided to a great extent by the powerful organisations which claim the transactions arising out of life contingencies as their own peculiar sphere. The wish that such may be the case must be my apology for traversing much familiar ground.

The system of granting life annuities appears to be legitimately traceable back to the 16th century, Walford remarking, in an interesting article in the "Insurance Cyclopædia," in which he cites examples, that during the greater part of that century probably much speculation was carried on in annuities by private dealers. It is commonly understood that this form of transaction was much resorted to in order to evade the repressive usury laws of

the period, which first forbade the acceptance of interest and afterwards limited the rate at which money might be lent, the line of argument being that where an annuity was granted for money advanced there was no specific repayment of the principal sum transferred, and therefore that no loan was made—the transaction being, in fact, on the part of the capitalist, a purchase of a commodity in the shape of an annuity, and, as such, free from any statutory interference. Walford seems to go further than other authorities in suggesting that the system of granting loans repayable by annuities on lives had indeed been specially devised with the view to the evasion of the usury laws; however that may be, it is certain that life annuities were known to commerce long before the principles on which alone their value was correctly calculable had been discerned, and it may fairly be presumed that all these early transactions were essentially speculative.

Some progress towards sound financial principles in the grant of annuities appears to have been made in Holland under the guidance of De Witt, who made an important report upon the subject in 1671. Great Britain does not, however, seem to have shared in the benefits resulting from the principles here promulgated, for we find the English Government, shortly after the Revolution of 1688, offering life annuities of 14 per cent. per annum on the purchase money on single lives *of any age.* It is on record that the transactions resulting from this pioneer attempt of the State to augment its resources by the offer of annuities were not numerous—an effect, perhaps, of the low state of public credit at that time.

The next attempts of the Government to raise money by transactions involving consideration of the duration of life took the shape of "Tontines," this expedient being resorted to in the years 1692, 1765, and 1789. As these Tontine investments consisted in a species of life annuity, and the last of them supplied an important part of the data from which Finlaison prepared his famous Report of 1829, it may not be out of place to shortly examine them. In doing so I deal only with the last—that of 1789—the earlier ones being merely variants, on a small scale, of the last and largest operation of the kind. The sum subscribed in 1789 was slightly over £1,000,000, in shares of £100 5s. each. The consideration took the shape of annuities on lives to be nominated by the subscribers, these annuities being increased, as deaths occurred among the nominees, by the annuities falling in

time as the annuities should increase by survivorship to £1000 on each share of £100 5s., at which amount they thereafter remained fixed until the death of the nominee, when the liability of the Government ceased. The shares were divided into six classes, according to the ages of the nominees, and the several rates of annuity allowed were as follows:—

First Class,		under	20	years of age,	£4	3	0	per annum.
Second „	20	and under	30	„	4	5	6	„
Third „	30	„	40	„	4	8	6	„
Fourth „	40	„	50	„	4	13	6	„
Fifth „	50	„	60	„	5	1	6	„
Sixth „		over	60	„	5	12	0	„

Owing to the partial failure of the plan a large proportion of the shares was perforce taken up by the Government itself, and the lives nominated in connection with these shares were selected from the Peerage, Baronetage, Justices of the Peace, Governors of Public Charities, &c.

So far as the investors were concerned, the attractiveness of this plan was evidently expected to lie in the element of speculation, the rate of interest in perpetuity yielded by Consols at their then price being as high as 4 per cent. Having regard to the probable results of the rough division of the nominees into age-classes, a certain advantage accrued to the investors (taking them in the mass), whilst, so far as the State was concerned, the plan possessed the merit of insuring the redemption of debt within a reasonable period of its contraction. Whether these favourable elements counterbalanced the demoralising gambling element of the scheme is a question of ethics upon which I do not propose to enter.

Annuity business in its modern form may be said to have commenced in this country in the year 1808, when the Government established the granting of life annuities as a branch of the National Debt operations, the object being "to effect a reduction of the National Debt by the voluntary commutation of perpetual Stock into annuities, which return larger annual payments, but which are limited by the length of the lives for which they are granted."* Consistently with this object, the annuity granted in every case was dependent upon the amount of Stock which the

* Report of Mr. A. J. Finlaison, 1883.

(or rent) of the annuity was regulated not only by the capital sunk, but also by the market price of Stock on the day the bargain was concluded. As regards a portion of the Government annuities, however—namely, the Savings Bank Life Annuities, which are limited to £50 per annum in each transaction—the more common system of a fixed scale has been adopted—this being variable, certainly, from time to time as circumstances may dictate, but throwing upon the Government the risk incidental to the value of Stock when individual bargains are made.

Other public bodies have resorted occasionally to the annuity system of raising money—the City of London, for example, having obtained large sums in this way at the end of the 18th century. The most notable instance in recent years is the Manchester Corporation, which, under its Waterworks Act, has obtained very considerable sums since 1859 by the sale of annuities. A report of Mr. Finlaison shows, however, that up to 1882 this authority was, by the terms it offered, virtually paying $4\frac{3}{4}$ per cent. for the accommodation, a circumstance which possibly accounted for the large business which it was doing. In 1882 the rates were considerably diminished by the adoption of the (old) scale employed by the Government on such dates as the 3 per Cents. might be at par.

The first results of the annuity transactions of the Government were disconcerting. The general measure of the duration of life at that date was, by force of circumstance, the Northampton Table, and the new life annuities were based upon such table. It was, however, well known that the use of this standard by the Equitable Society for the granting of life assurances had endowed that Society with a quite remarkable measure of prosperity, and it is inconceivable that the bearing of such a table on a life annuity business was not observed—that "the tables which were so gainful to the Equitable, who, in the shape of premiums, *purchased* life annuities, must be ruinous to the public revenue, which was to *sell* them." * Such, however, was the case—the Northampton Table was adopted, and its use maintained until, in 1828, the system was suspended on the strenuous advice of Finlaison, who showed that the loss to the country had then attained to the enormous sum of *£8000 per week*.

* Memoir of John Finlaison, J.I.A., vol. x., p. 158.

servants) had been appointed Actuary to the National Debt in 1822, and in 1829 he produced the first compilation of Annuitant Experience in this country. His materials were supplied mainly by the records of the National Debt Office in respect of annuities which had been granted since 1808 and the Tontine nominees under the scheme of 1789 above described.

The annuity values deduced by Finlaison were widely different, as was to be expected, from those on which the Government had been relying, and it was also shown that the vitality of females was so far superior to that of males as to require separate tables for the sexes.

The following figures show impressively the need there was for this investigation. It will be seen that the "mean after-lifetime," at the several ages quoted, is greater throughout in the case of males, and considerably greater in the case of females, by the Government Annuitants Experience than by the Northampton Table. When I remind you that the mean after-lifetime—or expectation of life, as it is more frequently but less accurately termed—is simply the value of an annuity on the assumption that money earns no interest, the loss which the Government suffered by the use of the Northampton Table in a large annuity business will be appreciated.

Age.	Mean After-Lifetime.		
	Northampton.	Government 1829. Males.	Government 1829. Females.
	Years.	Years.	Years.
50	18·0	20·3	24·4
60	13·2	14·4	17·3
70	8·6	9·2	11·0
80	4·8	4·9	6·5

In 1860 the results of a second investigation of annuitant life were published, these being prepared by A. G. Finlaison. This observation confirmed the reliability of the first investigation so far as males under 70 were concerned, but showed an increased vitality at the higher ages. The duration of life of female nominees was found to be less at all ages than that exhibited by the previous observation, but the difference was ascribed to the correction, by the efflux of time, of a defect in the original data, and not to any supposed decrease in the vitality of females.

The third, and most complete, investigation of the Government Annuity Experience was carried through by the late Mr. A. J. Finlaison. Mr. Finlaison's investigation was based entirely upon the records of the National Debt Office, and it embraced the whole period from 1808—the date at which the Government first entered upon the business—to 1875. During this long period of 67 years the National Debt Commissioners had granted annuities on the lives of 30,788 persons, nearly two-thirds of whom were females, and of whom 22,998 had died, leaving barely 8000 under observation at the final date. The experience is thus unusually exhaustive, and its scientific value is enhanced accordingly.

This investigation is of special value as being the first in which the principle of "selection" was recognised in connection with annuity transactions. Mr. Finlaison discarded the method, previously employed, of aggregating all the facts relating to a common experience age and of deducing therefrom a rate of mortality supposed to be applicable to all lives attaining that age without exception, and scheduled the facts in classes corresponding with successive ages at admission. By this means he was enabled to separate the experience of the first few years after purchase from that of the subsequent periods, and so to determine whether, and to what extent, the nominees coming under observation immediately after purchase were superior lives in comparison with nominees of like ages on whose lives annuities had been running for considerable periods. The wisdom of the course thus taken was, in the result, abundantly proved. It was found that the vitality of recently-entered lives was much superior to that of nominees of like ages who had been longer under observation, and that an important difference in values thereby resulted; the reality of the discrimination exercised by persons seeking to purchase life annuities may be understood to have been finally established by this investigation.

most important, analysis of the experience of annuitant life—the new investigation based upon the records of Life Offices in the United Kingdom, and conducted jointly by the Institute of Actuaries and the Faculty of Actuaries. This experience—a report of the elemental facts of which has recently been issued by the Joint Committee—covers a shorter period than that of the National Debt Office, viz. 30 years, but is certainly not of less value on this account. Clearly, if the common supposition of an improvement in the duration of life in recent years be well founded, an experience which relates to the latter portion of the 19th century should be of far greater value for practical purposes than that which is derived in great part from the records of an earlier period.

This experience appears to include a somewhat larger number of cases than that of the Government annuitants—viz., 8641 males and 23,056 females. It is interesting, however, to find that the 8641 male annuities depended only on 6728 lives, and that the 23,056 female annuities similarly depended on only 18,951 lives, thus showing a considerable extent of duplicate cases.

The new experience has also been tabulated in the "select" form, and the method has been followed to a greater extent than in Finlaison's observations (1883), with the result that the influence of selection seems to be discernible for at least ten years after purchase. The following extracts, giving the "Expectations of Life," deduced (from the ungraduated data) for three divisions,

(*a*) The Aggregate Experience,
(*b*) The Experience after the first five years,
(*c*) The Experience after the first ten years,

show a marked decline in the expectancy as the volume of excluded data increases, thus proving that the deaths in the first and second five years after purchase are in smaller proportion to the number of exposures than in the after experience at the same ages. That lower death-rates prevailed in the first five years was to be expected, but that the effects of self-selection are traceable for so long a period as ten years is, I venture to think, somewhat remarkable.

[Table.

LIFE OFFICES ANNUITY EXPERIENCE.

Age Attained.	Complete Expectations of Life (Unadjusted Data).					
	Male Lives.			Female Lives.		
	Aggregate Experience.	Aggregate less first 5 years.	Aggregate less first 10 years.	Aggregate Experience.	Aggregate less first 5 years.	Aggregate less first 10 years.
	Years.	Years.	Years.	Years.	Years.	Years.
50	21·04	19·73	19·69	24·21	23·13	22·95
60	14·86	14·21	13·48	16·97	16·41	16·18
70	9·25	8·86	8·63	10·50	10·25	10·12

It will be observed from the above Table that the experience corroborates previous observations as to the superior longevity of female nominees, and the following extract from the Report shows that in respect of both male and female lives the longevity of Life Office annuitants is superior to that of the nominees included in the Government experience—the difference being the most strongly marked in the case of females.

Age at Purchase.	Complete Expectations of Life at Date of Purchase.			
	Male Lives.		Female Lives.	
	Life Offices Experience.	Government Experience.	Life Offices Experience.	Government Experience.
	Years.	Years.	Years.	Years
50	20·64	20·26	24·06	22·92
60	14·96	14·38	16·82	16·26
70	9·37	9·33	10·65	10·30

purchased, the following Table will be of interest. It is evident that the most general purpose for which annuities are sought is that of an income during the decline of life; but it may occasion some surprise to find that so many of these annuities were purchased after the age of 70 had been passed.

CLASSIFICATION OF ANNUITANT-NOMINEES ACCORDING TO AGES AT PURCHASE.

Ages.	Life Offices Annuity Experience.				Government Experience, 1808–1875.	
	Males.		Females.		Males and Females.	
	Number.	Per Cent	Number.	Per Cent	Number.	Per Cent
Under 30	54	1	144	1	414	1
30–40	142	2	392	2	1,283	4
40–50	491	7	1,435	8	3,826	13
50–60	1,521	21	4,766	25	9,167	30
60–70	2,942	40	8,073	43	10,854	35
70–80	1,806	25	3,641	19	4,654	15
Over 80	296	4	476	2	590	2
Total, .	7,252	100	18,927	100	30,788	100

It will be seen from the foregoing that the tendency amongst females is to purchase annuities at somewhat younger ages than amongst males, and that amongst the Government annuity-nominees the average age at purchase is distinctly under that of the nominees purchasing from Life Offices. This is probably due to the circumstance that a proportion of the annuities granted by Government are purchased by Trustees and Executors, and

fall outside the class which is specially concerned in these transactions. It may be mentioned, too, that of the Government annuities some 300 at ages of 73 and over formed part of a body of annuities on male lives which were purchased many years ago by certain speculators in this class of business. Were this section excluded, the disparity in average age between the purchasers of ordinary annuities from the Life Offices and from the Government would be even more clearly apparent.

In the compilation of the new experience advantage has been taken of the rare opportunity afforded to compare the mortality amongst the survivors of one generation of annuitant-nominees with that experienced during the period of observation by the succeeding generation, the facts having been scheduled in two divisions comprising respectively the lives on which annuities were purchased before and in and after the year 1863. The form in which the data are presented enables us to compare the experience of the two classes, and with the view of ascertaining whether and how far the mortality of the two classes may differ, the following short Table has been prepared from the facts scheduled. I have accepted the apparent conclusion of the compilers that selection may be "assumed to be eliminated after ten years," and have had recourse only to the data referring to the eleventh and subsequent years of observation. The "Old" Annuities were purchased before 1863, the "New" Annuities in and after that year.

[Table.

Ages.	Males.		Females.	
	Old.	New.	Old.	New.
40–42	..	..	·038	·007
43–45	..	..	·019	·010
46–48	·025	·028	·004	·018
49–51	·016	·020	·013	·018
52–54	·022	·014	·013	·013
55–57	·011	·029	·017	·018
58–60	·053	·041	·024	·014
61–63	·038	·044	·024	·021
64–66	·046	·046	·031	·034
67–69	·046	·045	·040	·039
70–72	·074	·068	·049	·051
73–75	·085	·085	·063	·065
76–78	·103	·099	·092	·082
79–81	·151	·129	·118	·110
82–84	·169	·181	·142	·151
85–87	·200	·210	·187	·197
88–90	·304	·284	·223	·240
91–93	·223	·261	·292	·251
94–96	·270	·235	·312	·293
97–99	·190	·333	·302	·444
100–102	..	..	·462	·500

It will be seen from the Table that no material difference between the mortality of the "Old" and "New" divisions is discovered. The rates, being unadjusted, are, of course, irregular in gradation, but the cases of excess in the mortality of one division over that of the other are fairly equally balanced. In the case of the males there are eight groups of ages in which the "Old" annuities show higher mortality rates than the "New" annuities, eight in which the latter show the higher rates, and two in which the rates are equal. In the case of the females, the respective cases of excess are "Old" annuities 9, and "New" annuities 11, and in one group the rates are equal.

The general agreement of the two sets of data is somewhat more clearly exemplified by comparison of the actual numbers of

deaths in each with the expected numbers derived from a common standard—say the Government Annuitants Experience. Such comparison shows that in respect of male lives—

(*a*) The expected number of deaths amongst the "Old" annuity nominees was 1051 and the actual number 1044, the ratio of actual to expected thus being 99 per cent.

(*b*) The expected number of deaths amongst the "New" annuity nominees was 899 and the actual number 880, the proportion thus being 98 per cent.

The female experience shows like features, whilst bringing out very clearly the low mortality rates which have generally prevailed amongst this class of lives. The "Old" annuities show expected deaths 3470 and actual 3299, or a ratio of 95 per cent., and the "New" annuities show expected 2968 and actual 2805, or a ratio of 94½ per cent.

The publication of the new experience gives occasion for discussion as to the probable changes pending in the practice of Life Offices with respect to this important branch of business. Reserves and prospectus rates will, presumably, come under review, and it is to be assumed that in both respects a certain amount of revision of existing arrangements will be considered necessary.

With respect to reserves, I have thought it might be of interest to briefly examine the changes which have been made during the last twenty years in the valuation of annuities, and for this purpose have compiled the subjoined Table, which shows the number of Offices employing each of the several designated Mortality Tables at their valuations nearest before the years 1880, 1890, and 1900 respectively. I had some intention of analysing also the changes made—principally reductions—in the rates of interest employed in these valuations, but on consideration decided not to proceed further with this point. Changes in the tables employed may, speaking generally, be deemed to result from the necessity for a more exacting measure of the duration of life, whilst reductions in interest are traceable rather to that universal recognition of the desirability—if not the absolute necessity—of strengthening all reserves which in recent years has been so marked a feature of Life Assurance finance. It will be seen by reference to the Table that the Carlisle and Equitable Tables, both of which found considerable favour at one time for the valuation of annuities, are tending to fall into desuetude; the

purpose can scarcely be justified on scientific grounds. The special tables employed by some Offices for valuations are the Office rates for granting annuities, and may presumably be classed with the stronger bases. The majority of the changes have evidently consisted in the substitution of the Government Annuities Experience for less exacting standards, and indeed the tendency seems to be towards the universal adoption of this experience. Needless to say, it will be an easier matter for those Offices to pass to the New Experience Tables which are already employing the Government Annuitants Table—especially in conjunction with a low rate of interest—than for the Offices which have adhered to the older and less stringent bases.

Life Table.	Employed in Valuation nearest before		
	1880.	1890.	1900.
Northampton, . .	By 2 Offices.	By 1 Office.	By — Offices.
Carlisle, . . .	„ 14 „	„ 12 Offices.	„ 4 „
Equitable, . .	„ 8 „	„ 3 „	„ 1 „
Hm. and 17 Offices, .	„ 13 „	„ 10 „	„ 6 „
English Life, . .	„ 3 „	„ 3 „	„ 3 „
Government Annuities,	„ 18 „	„ 35 „	„ 46 „
Manchester Unity, .	„ 1 „	„ 1 „	„ 1 „
Special, . . .	„ 8 „	„ 7 „	„ 4 „
	*67 „	†72 „	‡65 „

* Including 4 Offices using two tables.
† „ 5 „ „ „
‡ „ 2 „ „ „

With respect to the probable changes in prospectus rates, it is desirable, in the first place, to consider how nearly the Government Experience rates compare with those deduced from the new tabulation, and for this purpose I have compiled the following statement. It should be explained that I have assumed that of each £100 purchase money £2 will be absorbed in initial expenditure, leaving £98 as the net purchase price, and that pending the issue of the graduated tables the unadjusted annuity values published in the Report of the New Experience have been taken.

It may be assumed that these are sufficiently near to the probable ultimate values for comparative purposes. The rate of interest employed is 3 per cent. per annum, and the annuities are taken as payable half-yearly, with a final payment of three months' rent in the half-year of death.

ANNUITY PURCHASED BY £100 AT CERTAIN AGES, BY THE GOVERNMENT ANNUITIES (1883) EXPERIENCE AND THE NEW (LIFE OFFICES) ANNUITY EXPERIENCE (UNADJUSTED VALUES).

Ages.	Males.			Females.		
	Government Annuities.	New Experience.	Percentage of New Experience Annuity to Government Annuity.	Government Annuities.	New Experience.	Percentage of New Experience Annuity to Government Annuity.
	£ s. d.	£ s. d.		£ s. d.	£ s. d.	
50	6 18 0	6 18 0	100	6 5 3	6 3 0	98
60	8 17 10	8 14 0	98	8 0 8	7 16 0	97
70	12 13 2	12 13 0	100	11 12 2	11 0 0	95

From the above, it appears that so far as male lives are concerned the annuity rates deduced from the latest Government Annuitants Experience will still be fairly sufficient at the common purchasing ages, but that in order to meet the new conditions the rates of female lives will have to be diminished by proportions varying from 2 to 5 per cent. The Offices adopting a basis such as here employed will still be able, it would seem, to offer better terms in the generality of cases than the National Debt Office, the rates granted by which, owing to the low rate of interest necessarily assumed, are considerably below the general average.

The following Table shows in summary form how the existing prospectus rates of practically all the Offices doing annuity business compare with the Government Annuitants rate calculated by the standard method above assumed. Forty-two Offices are brought

one-third of these are granting larger annuities than the Government Experience provides, and some of these will probably find it desirable to revise their offers. In the case of female lives, about 25 per cent. of the Offices are granting larger annuities than those deduced from the Government Experience, and nearly as many are giving practically the Government Experience rates. In only two or three cases are the rates so far below the standard employed as to place the suitability of the existing scales beyond doubt when comparison is made with the New Experience.

Office Rates in Comparison with Government Annuitants Experience Rates (1883).	Males.		Females.	
	Age 60.	Age 70.	Age 60.	Age 70.
3 to 5 per cent. more . .	4	4	3	2
0 to 2 per cent. more . .	8	13	6	13
Equal (approximately) . .	11	9	13	5
0 to 2 per cent. less . .	9	7	13	10
3 to 5 per cent. less . .	8	4	5	8
Over 5 per cent. less . .	2	4	2	3
	42	41*	42	41*

*One Office does not quote at the age of 70.

Deferred Annuities.

The importance of this class of annuities is scarcely to be measured by the number of policies assuring them which are existing in the registers of the various Life Offices and in the Post Office Annuity Department. For the ordinary deferred annuity vesting at a stipulated age and frankly developing the benefit of survivorship, the public seems, it is true, to have but

little taste; but as, in conjunction with other benefits, a deferred annuity is provided by many mutual provident Associations, this type of assurance comes fairly frequently under the notice of the actuary. There are cases in which two forms of deferred annuity are provided by the same Society or Fund—viz., an annual allowance to the subscriber in old age and a survivorship income to his wife during widowhood, but this substantial dual provision cannot be said to be very frequent, while it is often the product of a considerable subsidy from employers or other sources. The Friendly Societies have done something in the same direction, but whilst amongst these bodies the assurance of deferred annuities in substitution for sickness pay in the decline of life is making progress, the provision of widows' annuities has all but disappeared with the collapse of the older Funds which systematically endeavoured, with the usual unhappy result, to make ten shillings do the work of a sovereign. If I may say so much, I would suggest that certain modern institutions of undoubted position seem not unwilling to encourage the lingering public belief in the mystic power of accumulation, which, without the financial guidance which the Life Assurance Companies can now command, has sometimes proved so hurtful in the past. "Old age pensions"—surely a misnomer for benefits purchased by periodic premiums—decked out with inviting options, and investing the assured with a measure of control over the sums supposed to be hypothecated to the central purpose of providing an income during aged life, are so attractively displayed that the unreflective investor may well be forgiven if in his innocence he should imagine that the modern actuary has divined the secret which eluded the ancient alchemist. Speaking for myself, I confess a preference for the simple deferred annuity with all its chances and probabilities, and I have been glad to note its progress, in a great industrial organisation which it is my privilege to advise, in comparison with that of a parallel system garnished with the inducement of a return of premiums in case of non-survivorship, and which has been altogether out-distanced by its modest rival.

One of the most interesting, and probably the most important, of the deferred annuity systems at present in existence is that established under the Elementary School Teachers Superannuation Act, 1898. Although outside the immediate scope of our subject, this scheme presents such features of interest to those engaged in

will not be out of place. It may be said that, in addition to the deferred annuity, there is a considerable subsidy in the shape of a superannuation benefit for those teachers who have accepted the Act, this benefit being provided wholly from public funds. The scheme is optional with all teachers in the service in 1899, but compulsory on all teachers certificated after that date, a circumstance which ensures for it a future of great importance to the profession concerned and to the State.

The contributions of teachers to the Deferred Annuity Fund are, in the case of males, £3 per annum, and in the case of females £2 per annum, these payments continuing until the anniversary of entry preceding the 65th birthday. The annuities then entered upon depend in amount upon the number of contributions made, and, approximately, a male teacher is entitled to twice the amount allowed to a female teacher. Thus, a male teacher entering at 20 and making 45 payments of £3 is entitled to £39 8s. 10d., whilst a female contributor is entitled to £19 15s. 8d. after 45 payments of £2. A male contributor entering at 30 is entitled at 65 to an annuity of £24 13s. 7d., the corresponding rate for females being £12 16s. 2d. It is curious to find that these rates are considerably under those offered by the Post Office Deferred Annuity Scheme to the public generally—which must, of course, be held to include members of the body of elementary teachers—the difference at the youngest ages at entry being rather more than ten per cent. No doubt there is sound reason for the difference, but it is not clear whether it arises from the assumption of a lower rate of interest in the case of the teachers' fund, or upon the calculation of the expected survivorship on a more stringent life table. If the latter is the case the Treasury would confer a boon upon the actuarial profession by publishing the table used, for, despite the advance which our branch of science has made, we are still very much at a loss for accurate measures of the mortality prevailing amongst special classes of the community, and any authentic records relating to the experience of this section of the scholastic profession would be a valuable addition to our statistical resources.

The most striking feature of this scheme is the condition that every payment of a premium purchases a definite and acknowledged portion of the deferred annuity, and that, consequently, there can be no such element as lapse or withdrawal. If a teacher

retires from the service the annuity is not forfeited; so much of it as is purchased by every past payment made stands to his (or her) credit, and is claimable on survival to 65 and thenceforward during life. Thus, in the case of a male—

the £3 paid at the age of		20	purchases an	annuity	after 65 of	£1	13	8
,,	,,	30	,,	,,	,,	1	4	9
,,	,,	40	,,	,,	,,	0	17	6
,,	,,	50	,,	,,	,,	0	11	10
,,	,,	64	,,	,,	,,	0	6	1

the scheme for women being the same, but the amounts being necessarily smaller.

So far as I am aware this method of stating the process by which a deferred annuity is purchased was proposed by the late Mr. Sutton in a Report which he prepared in 1891 for the guidance of the Select Committee of the House of Commons which examined the abortive Superannuation Scheme of the London School Board, but I am not aware of its practical adoption previous to the present scheme. It appears to me to be an admirable condition of a deferred annuity contract, and it is possible that its general adoption would do much to bring such annuities into favour with the provident classes. Forfeiture, in the event of failure to keep up a policy, is, rightly, repugnant to sound Insurance practice, but there is scarcely anything so difficult to estimate as an equitable surrender value of a deferred and perhaps far-distant annuity, and this simple provision of an automatic paid-up benefit appears worthy of general acceptance.

ALFRED W. WATSON, F.I.A.,

Insurance and Actuarial Society of Glasgow,
March 11th, 1901.

APPENDIX.

Elementary Note upon the Theoretical Value of an Annuity.

The simplest annuity is that which is payable for a "term certain"—that is for a fixed number of years without reference to the duration of any life. If, in the first place, it be assumed that no interest is obtainable by investment of capital, the value of the annuity is identical with the total sum to be paid—that is with the annual payment (or "rent") multiplied by the number of payments, an annuity of £1 (per annum) for ten years being thus worth £10. As, however, money can always be invested at some rate, large or small, the practical value of an annuity is that sum which, being invested at the outset, will yield the periodical payments as they become due, partly by the accumulating interest and partly by the release of the capital invested, and become exhausted with the last payment under the agreement. Thus, the value of a payment of 1 for, say, 5 years is equal to the sum which, invested at the agreed rate of interest,

	Will accumulate to 1 at the end of 1 year.				
Plus	do.	do.	do.	do.	2 years.
	do.	do.	do.	do.	3 years.
	do.	do.	do.	do.	4 years.
	do.	do.	do.	do.	5 years.

If the rate of interest be 3 per cent., a brief arithmetical calculation will show the terms of such a series to be respectively—

For the payment 1 at the end of			1 year, .	.	£0 19	5
Do.	do.	do.	2 years, .	.	0 18	10
Do.	do.	do.	3 years, .	.	0 18	3½
Do.	do.	do.	4 years, .	.	0 17	9
Do.	do.	do.	5 years, .	.	0 17	3
Giving a total, as the value of the annuity, of				.	£4 11	6½

When the element of the duration of life is introduced the value of such an annuity is reduced, because each payment is conditioned with the stipulation that the life on which the annuity depends shall be in existence at the date when that payment falls due. Obviously it cannot be predicted, in the case of an indi-

vidual, which of the payments under this contribution will have to be made and which will fail, but assuming a sufficiently large number of transactions, and assuming that he has reliable data as to the probabilities of life amongst the class with which he is dealing (and this is a very important point in all calculations of this kind), the actuary can predict with fair confidence *how many* payments will have to be made at the expiration of each period, though he cannot specify the persons who will be the recipients.

To show the value of such an annuity, I must ask you to study briefly the form of a "Life Table" as expressed in the following extract from the familiar HM. Table. You will observe that there are four columns—the first giving the age, the second the number of survivors at that age, the third the number of such survivors who die within the year, and the fourth the probability of living one year.

Age.	Living at the Beginning of the Year.	Dying during the Year.	Probability of Living One Year.
90	1273	402	·684
91	871	296	·660
92	575	209	·637
93	366	144	·607
94	222	93	·581
95	129	58	·550
96	71	34	·521
97	37	18	·514
98	19	10	·474
99	9	5	·444
100	4	3	·250
101	1	1	·000
102	0	..	..

If the quantities in the last column—the probabilities of living one year—be examined, they will be found to be derived by dividing the number living at each age into the number living at the *next age*. Thus the probability of living a year at age 90 is the equivalent of the fraction $\frac{871}{1273}$ or ·684, and the probability of a person of 95 living to reach the age of 96 is similarly $\frac{71}{129}$ or ·550. The reasoning of this seems obvious.

To obtain the value of a life annuity, therefore, it is necessary to know what is the probability that a person of an assigned age

ages which it comprises the above Table affords us the means of obtaining this information. For example, if the probability of a person of 90 years of age surviving one year be ·684, and the probability of a person of 91 surviving one year be ·660, the probability that a person of 90 will survive *two years* is obviously equal to the probability that he is still alive at 91, multiplied into the probability that a person of 91 will still be alive at the age of 92, or ·684 by ·660, which is equal to ·451. Similarly, the probability of survival for three years is equal to the probability of survival to 92 multiplied into the probability that a person of 92 will survive to 93—*i.e.*, ·451 by ·637, which is equal to ·287.

In such manner the probabilities of a person of 90 years of age surviving to the ages of 91, 92, 93, etc., to the extremity of life, which the table indicates as 102 years, may be severally determined.

There is another and shorter method by which these essential factors may be determined. If the number of persons alive at 95, out of 1273 who entered upon the age of 90, is 129, the probability of a person of 90 surviving to 95 (assuming always that we know nothing of the health of the *individual*) is $\frac{129}{1273}$ or ·101. The rule may be thus expressed:—The probability of a person of any assigned age surviving to any higher age is obtained by dividing the number of persons living, according to the life-table, at the higher age by the number living at the first age; and the application of this rule gives us the following series of probabilities applicable to the age of 90:—

Probability of surviving	one year,	. .	871 ÷ 1273 = ·684
Do. do.	two years,	. .	575 ÷ 1273 = ·451
Do. do.	three years,	. .	366 ÷ 1273 = ·288
Do. do.	four years,	. .	222 ÷ 1273 = ·174
Do. do.	five years,	. .	129 ÷ 1273 = ·101
Do. do.	six years,	. .	71 ÷ 1273 = ·056
Do. do.	seven years,	. .	37 ÷ 1273 = ·029
Do. do.	eight years,	. .	19 ÷ 1273 = ·015
Do. do.	nine years,	. .	9 ÷ 1273 = ·007
Do. do.	ten years,	. .	4 ÷ 1273 = ·003
Do. do.	eleven years,	. .	1 ÷ 1273 = ·001
Do. do.	twelve years,	. .	0 ÷ 1273 = ·000

Combining now the several probabilities of life with the element of interest, we are in a position to ascertain the value of a life annuity. Thus, the value of the first payment being the value of £1 payable at the end of *one* year, multiplied by the probability of living one year, is at 3 per cent., in the case of a person of 90 years of age, 19s. 5d. multiplied by ·684, or 13s. 3½d.

Similarly, the value of the second payment is—

		18s.	10d.	multiplied by	·451, or 8s. 6d.
Do.	third do.	18s.	3½d.	do.	·288, or 5s. 3d.
Do.	fourth do.	17s.	9d.	do.	·174, or 3s. 1d.
Do.	fifth do.	17s.	3d.	do.	·101, or 1s. 9d.
Do.	sixth do.	16s.	9d.	do.	·056, or 11d.
Do.	seventh do.	16s.	3d.	do.	·029, or 5½d.
Do.	eighth do.	15s.	9½d.	do.	·015, or 3d.
Do.	ninth do.	15s.	4d.	do.	·007, or 1½d.
Do.	tenth do.	14s.	10½d.	do.	·003, or ½d.
Do.	eleventh do.	14s.	5½d.	do.	·001, say nil.
Do.	twelfth do.	14s.	0½d.	do.	·000, nil.

And the value of the whole annuity is the sum of these separate values, or £1s. 13s. 8¼d. Whilst, therefore, the annuity *may* be drawn for eleven years (the Table indicating a possibility of survival to the age of 101, but not to the age of 102), and *may* represent a maximum value at the outset, according to an ordinary interest Table, of £9 5s. 0½d., the influence of mortality is such that the *average* value at the outset is only £1 13s. 8¼d.

The example is, of course, an extreme one, but the method of deducing the annuity value is in principle the same, whatever the age may be.

The problem may be viewed in a slightly different and equally instructive way by regarding only the third column of the abbreviated "Life Table" in conjunction with a table of the values of "annuities certain"—the construction of which we have already examined. On inspecting the "Life Table," we find that 402 of the 1273 persons who are living at the age of 90 do not survive to the age of 91, and therefore draw no payment of the annuity which we are to suppose begins to run from the age of 90, and is payable in yearly instalments, the first of which accrues due at the end of one year—*i.e.*, on the day on which the age of 91 is reached. In 296 cases one instalment is drawn, but not a second; in 209 two instalments are drawn, but not a third, and so on to the end of the Table, which is reached at the age of 101, where we find that one person draws an eleventh instalment, but that none live to reach the twelfth.

The 1273 supposed annuity contracts thus include 402 under which no payment is made, and the value of which at the outset is nil. (*Note.*—The reader must keep clearly in view that whilst it is known that 402 of the annuities will lapse before a single payment accrues due, and that whilst it is quite correct therefore to say that the value of these 402 contracts is nil, it is *not* known *which* of the 1273 contracts are to be placed in that category.)

296 annuities entail but one payment, and the value of these is 296 by 19s. 5d.

209 annuities entail two payments, constituting 209 annuities certain for 2 years, the value of which is 209 by £1 18s. 3d.

certain for 3 years, the value of which is 144 by £2 16s. 7d.
93 annuities entail four payments, constituting 93 annuities certain for 4 years, the value of which is 93 by £3 14s. 4d.
58 annuities entail five payments, constituting 58 annuities certain for 5 years, the value of which is 58 by £4 11s. 7d.
34 annuities entail six payments, constituting 34 annuities certain for 6 years, the value of which is 34 by £5 8s. 4d.
18 annuities entail seven payments, constituting 18 annuities certain for 7 years, the value of which is 18 by £6 4s. 7d.
10 annuities entail eight payments, constituting 10 annuities certain for 8 years, the value of which is 10 by £7 0s. 5d.
5 annuities entail nine payments, constituting 5 annuities certain for 9 years, the value of which is 5 by £7 15s. 9d.
3 annuities entail ten payments, constituting 3 annuities certain for 10 years, the value of which is 3 by £8 10s. 7d.
1 annuity entails eleven payments, constituting 1 annuity certain for 11 years, the value of which is 1 by £9 5s. 0½d.

The aggregate value of these eleven classes of annuities is £2147 0s. 9½d., and this is at the outset the aggregate value of the whole payments to be made during the currency of the 1273 lives. Clearly, therefore, the value of the payment on any one life, remembering that it is not known beforehand in which one of the twelve classes it should be placed, is £2147 0s. 9½d. divided by 1273, or £1 13s. 8¼d.

These examples will serve, I trust, to illustrate the general principles on which the value of a life annuity is determined, and by which the values of the several variants from the most elementary type—the annuity payable by instalments at longer or shorter intervals than one year, the deferred annuity vesting at the end of a term of years, or on the determination of a given life, if the life on which the annuity depends (technically termed the "nominee") be then in existence, and the temporary annuity—are ascertained by the introduction of the necessary qualifying conditions into the problem. A perusal of the foregoing and other papers will have warned you that there is no such instrument as a universally applicable standard of these values, either so far as concerns the duration of life or the interest of money, and will have prepared you to appreciate my concluding remark that every life annuity must be judged with strict relevance to the status of the nominee on which it depends and the purpose for which the value is sought. If this be clearly kept in view, the risk of a fallacious use of the Tables which are occasionally found in the works of the "ready reckoner" type, and which seem (to adopt the title of a famous work) to have the object of making "every man his own actuary," will be very greatly minimised.

LIFE ASSURANCE PROSPECTS AT THE OPENING OF THE TWENTIETH CENTURY.

In selecting a subject for my address to-night I could not resist the alluring influence of the retrospective and prospective frame of mind prevalent at the birth of a new century. My title suggests a wide range of thought, but I need hardly say that I can only express my views on a limited number of the practical problems of Life Assurance confronting us in this country at the present moment. The solution of these, however, must have an important bearing on the conduct of Life Assurance iu future, and I might even add on the national well-being, as the latter is, to some extent, influenced by the former. As a preliminary, it would have been well to take a brief survey of the developments of Life Assurance in the latter part of the last century, but these have already been so recently and efficiently dealt with by the Insurance press that I will spare you such a preface to-night; moreover, are they not written in that admirable volume, so opportunely published, the "Insurance Guide and Handbook" (third edition), which contains, in a compendious and readable form, a comprehensive history and exposition of the principles and practice of Life Assurance written up to date by an accomplished actuary?

The question doubtless at present uppermost in your minds is the new business of 1900, but I can say little on that subject, as the total figures are not yet published; but my general impression, gathered from the experience of many first-class Offices, is that there has been a difficulty in maintaining the figures of the previous year, which, as you know, was itself an unsatisfactory new business year. This has probably been due, in great measure, to the influence of the still unfinished South African War and the China imbroglio, which have unsettled the minds of

many investors, causing a postponement by some of so permanent a form of investment as life assurance. Increased taxation, and the substantial advance in the price of provisions and other necessaries, must have also had their effect; but yet another cause has been suggested to me—and I think there must be something in the suggestion—viz., that, paradoxical though it may appear, the better condition of trade in 1900 may have had a temporarily depressing effect on ordinary new business, inasmuch as moneys have been put into trade enterprise which would otherwise have been expended in life assurance—when, therefore, profits are realised and peace is restored, there will be a harvest for the alert and energetic agent—and I feel sure that you, gentlemen, will ere long be realising the results of the reaction in your new business returns to head Offices. The improvement in trade may, however, have had an opposite effect on new industrial business, as it is usually accompanied by a rise in the wages of the working classes, but against this must be set the more serious effect on such classes of a rise in the cost of living.

The low price of Stock Exchange securities and the high rate of interest ruling throughout the year, although improving the interest item of the revenue accounts, must also have caused in many Offices a diminution in the amount of new business written as collateral security for loans, inasmuch as many borrowers have postponed their requirements, and Life Offices have hesitated to sell convertible securities to place the proceeds in loans on mortgage. On the whole, therefore, I think there is little doubt that when the total figures of the new business of 1900 transpire they will show a considerable shrinkage in their total volume when compared with those of 1899, but have thought it well to allude to the matter by way of illustrating ome of the causes of depression in Life Assurance business. These, however, are only temporary influences on the business, and it is my intention to-night to dwell rather upon those forces which will have a more permanent effect on the quantity and quality of Life Assurance in this country in the near future.

In the first place, the force of competition occurs to one's mind as having a great effect on the business, whether for good or evil. Although the number of new Life Offices established in the United Kingdom during the last quarter of the nineteenth century might

door is always with us, and American and Colonial offices establishing their branches in this country have more than dispelled the danger to the public of a monopoly of the business by a few Life Offices. These importations from beyond the seas have not, however, necessarily created a supply of life assurance greater than the demand; indeed, they have rather appealed to the more opulent and speculative classes who did not previously contemplate life assurance as a satisfactory investment, and perhaps by their active propaganda and more attractive forms of life assurance have caused a greater demand and a better appreciation of its advantages and wonderful adaptability to the needs of persons in various stations in life. It is doubtful whether the limits of Life Assurance in its manifold forms have ever been approximately reached, so that there is, in my opinion, still scope for the enterprise of *all* the Offices now in operation in this country, and their friendly rivalry can only lead to improvements in the business in the interests of the public; but it is in the extravagant commissions and reckless expenditure of a few Offices, whether British, Colonial, or Foreign, that the dangers of competition lie, bringing discredit on the whole business by unsatisfactory financial results which disgust large sections of the public, and to some extent damage the interests of those Offices conducting their business on economical principles.

Judging, however, by the increasing number of intelligent enquiries from would-be assurers, there are not wanting signs that the persistent education of the public up to the leading principles of sound life assurance finance by the representatives of well-managed Offices, by the enlightening influence of the Insurance press, and by the various excellent guide-books now published, is beginning to tell its tale. At any rate, I am sure you will agree with me that the great proportion of British Life Offices, by declining to yield to the temptations of extravagant extension of business, will come out of the crucible of competition with increased prestige and the continued confidence of the Assuring public.

That the question of commission is of the first importance just now is evidenced by the fact that the late Lord Russell's Prevention of Corruption Bill is likely to be introduced into Parliament at an early date, piloted by such able and influential men as Lord Avebury and Sir Edward Fry. Some of the clauses of this Bill

are detrimental to the interests of Insurance business, and will require careful watching, and, if possible, combined action by the Insurance Offices to prevent serious interference with established practice in paying commissions which cannot be termed corrupt or illicit by even the most scrupulous of business men. The object o the Bill is shortly stated in the prefatory memorandum as follows :—

> "An effort to check, by making them criminal, a large number of *inequitable* and *illegal secret* payments, all of which are dishonest, and tend to shake confidence between man and man, and to discourage honest trade and enterprise."

Under the provisions of the Bill everyone who gives or offers, or any agent who asks or receives, commission without authority from or without the knowledge of the Insured, would be liable to fine and imprisonment, with or without hard labour. Such an enactment would deter a great many useful agents from continuing to introduce business for well-earned and rightfully-paid commissions, and the volume of new business would undoubtedly be seriously diminished, even to such an extent that ultimately there would be an appreciable increase in pauperism in the country, owing to the discouragement of the usual propaganda of thrift. Most assured persons have to be persuaded into life assurance, which they look upon as a luxury rather than a necessity, by the eloquence or influence of an agent, who must be paid by commission, or its equivalent, for his trouble.

The wording of this Bill is so extravagant that I have every hope that it will be crushed by its own weight; but, nevertheless, I think it is our duty as Insurance officials to endeavour to eliminate clauses detrimental to our business, and therefore I appeal to members of Insurance Institutes in the provinces to obtain the assistance of their local Members of Parliament to this end.

There is no doubt that some commissions are easily earned and some hardly earned, and the same might be said of many negotiation fees charged by Statute under the Solicitors' Remuneration Act for negotiating a sale, purchase, or mortgage; but the practice of paying solicitors, chartered accountants, and others commission for introducing insurance business has existed for many years, and

respecting them.

It has been suggested that Life Offices should combine to regulate commissions, both as to their amount and the proper persons to receive them; but there are serious difficulties in the way of a combination, such as the difficulty of fixing and enforcing a penalty for infringing established rules and the existence of foreign competitors. There can be no harm in attempting it, although I think it will be found that the only remedy is the existing one of publication of accounts and the persistent education of the public in the main characteristics of a carefully-managed Life Office. Perhaps, however, the best safeguard against the wasteful expenditure of policyholders' money is the fact that nearly all British Life Offices are now managed by professional actuaries, who can measure the disastrous financial effects of unprofitable and extravagant outlay upon so complex a business as Life Assurance.

Passing from the vexed and somewhat unpleasant question of commission, I have a few words to say as to another great force operating upon the financial results of Life Offices—viz., the rate of interest realised on their funds. From the numerous papers read on the subject at the various Institutes, we are well acquainted with the fact that in the last twenty-five years the all-round rate of interest realised by Life Offices has fallen perceptibly, at least ½ per cent., and now stands at about 3¾ per cent., instead of the 4½ per cent. rate realised at the opening of the last quarter of the past century. I say perceptibly, because the actual falling-off might be rather more than this, owing to the fact that many old loans still remain on the books of Offices, which, when paid off, may have to be renewed at a lower rate of interest. There is, however, some hope, fostered perhaps by the recent dearness of money owing to the war and other causes, that this fall in the rate of interest is not continuous, and that there may be a reaction in the near future. Undoubtedly we are on the eve of great developments in the Dark Continent of Africa, which, when more settled and civilised, must absorb huge amounts of surplus capital; and we may as a nation succeed in our efforts to open up sound commerce and trade in China, that mine of wealth and mystery. Again, there are the recent developments in the use of electrical energy, which must be the means of employment of large blocks of capital.

All these important movements will have the effect of relieving the over-accumulation of capital, although they do not directly provide means of investment of Life Assurance funds. But there is a movement of even greater immediate importance than any of the above, which is likely to improve the rate of interest, certainly for a time—namely, the coming great trade wars between the more advanced commercial nations, which is likely to stimulate manufacturers and traders to the employment of a large amount of capital to maintain their positions in the struggle for supremacy. Another, and more direct, influence on the rate of interest realised is the fact that the managers of Life Offices are more diligent than heretofore in seeking investments at home and abroad, offering good security but a higher rate of interest than ordinary trust securities; or in other words, that the field of investment has been enlarged by skilled enterprise. These various circumstances render me more hopeful of maintaining at least the present rate of interest realised on Life Assurance funds for many years to come.

But there is another influence operating in a favourable way upon the financial results of Life Offices, namely, the improvement which has taken place, and in my opinion a permanent improvement, in the rates of mortality, due to general advance in the knowledge and application of medical science, and the better sanitary provisions in this country under the Public Health Act. You are aware that the Institute of Actuaries (in conjunction with the Faculty of Actuaries in Scotland), the pioneer of all investigations into the mortality of assured lives, has recently completed a most searching investigation into the experienced mortality of sixty leading Life Assurance Offices during the period 1863-93. In order to compare, in a rough way, the general results of this investigation, I give here a comparison of the rates of mortality, at grouped ages attained, according to the 1863 HM Experience of 20 Offices and the New Experience Tables of 60 Offices, the figures being taken from the Summary Table for male lives assured at ordinary rates for the whole of life, with or without profits; and to illustrate the greater area over which the new statistics are spread, I may add that, in respect of the HM Tables, the total number of lives comprised in the Table was 130,243, having an average duration of 9·217 years, and of the New Experience Table 608,645 lives, with an average duration of 12·584 years—

Age Group.		Hm. Experience.	New Experience.
0— 9	...	·306	·152
10—19	...	·447	·378
20—29	...	·689	·589
30—39	...	·893	·743
40—49	...	1·205	1·152
50—59	...	2·019	1·998
60—69	...	4·061	3·970
70—79	...	8·445	8·479
80—89	...	17·591	17·522
90 and upwards		33·766	31·407

These figures show a marked improvement in the rates of mortality at every age group except at ages 70–79, and so tangible a gain must have a counteracting effect to the loss of profit from the fall in the rate of interest.

Besides the New Whole Life Assurance Experience, by this recent investigation separate mortality rates have been deduced from the statistics of the mortality experienced under special classes of assurance, such as endowment assurances, non-participating whole-life assurances, whole-life assurances by limited payments, term assurances, and assurances on female lives. The rates of mortality are still in their crude statistical form, or, to use the correct term, unadjusted, but they are sufficient to indicate that the new results confirm in a remarkable degree the results of previous more limited investigations into the peculiar features of the mortality of these special classes. For example, the rates of mortality in the endowment assurance class are lower than those in the whole-life assurance group, and, on the whole, the rates under non-participating assurances higher than under participating assurances. In the female experience, it is also found that, on the whole, the rates of mortality of the 1863-93 experience are lower than those of the female experience of 1863; and the new female rates also show the usual marked characteristics of female mortality experience, viz., a higher rate than males up to about age 45, and a lower rate than males at higher ages.

In recent years the marked fall in the average rate of interest earned by Life Offices has caused several Offices to raise their rates of premium, and others to strengthen their reserves, a few wealthy Offices having put them on a 2½ per cent. basis, one Office

calculating reserves at the fanciful rate of 2 per cent., which is chiefly evidence of large accumulated bonus reserves, and not a necessary precaution against insufficient reserve.

The fact, however, that there has been a definite improvement in the rate of mortality must check for a time the desire for an early move by all Offices towards reserves at 2½ per cent. interest, although we may reasonably anticipate a gradual movement towards that goal during the first half of this century; in the interests, however, of existing policy-holders it is desirable that such a change should take place over a long period of time.

The results of the New Mortality Experience, as stated above, must, however, be a solace to the large number of Offices who have been until now content, or obliged to be content, with 3 per cent. reserves and rates of premium based on the Healthy Male Experience of 1862, or on the "Select Life" basis (deduced from the same statistics) adopted by many Offices in recent years.

Owing to the force of competition, the increase of rates of premium, as the natural consequence of a reduced rate of interest, has not been so general as the tendency towards stronger reserves, the public being much more attracted by a moderate premium rate than the promise of bonus maintenance. The handsome bonuses of the nineteenth century must of necessity be, in most Offices, a pleasant memory only, inasmuch as the mortality gain has not balanced the permanent fall in the rate of interest, and there is a reluctance on the part of the Life Offices to defy public opinion by combining together (as the Offices have done in France) by generally raising premium rates to new entrants, in order to maintain bonuses at their former level. But for reasons which I have already stated I do not anticipate in the early part of this century a further general slump in bonus rates; old assurers are already used to the recent fall in bonus rates, and know that the cause is general, and new assurers should be thankful to be able to assure at present average participating rates of premium, and get the benefit of the interest profit on the strong reserves already accumulated. As to non-profit rates of premium there has been a tendency in recent years to reduce them to the lowest level consistent with safety, and the result of the New Mortality Experience seems to point to the desirability of a few Offices reconsidering their non-participating scales, which barely seem to cover risk and expenses. . It is always an enigma to the public why the

so widely; but, of course, the explanation lies in the different rates of interest and varying rates of commission and expenditure, so that I cannot foresee any possibility of bringing about by agreement a common scale of non-profit premiums for all Offices, as often suggested. There is a growing tendency towards special schemes of assurance without bonus, and I anticipate that in the new century the non-participating departments of our business will soon bulk more largely in our accounts; also, on the part of the public, the recent decline of bonus rates may produce some reaction in favour of a fixed assurance for a fixed premium, more especially in those Offices whose bonus rates have declined to such an extent that they are no longer an equivalent for the difference between a with-profit and a without-profit premium. In my opinion, however, the bulk of the business will still continue to be written on the participating scale, which appeals to the speculative instincts of the policy-holder, and provides a margin of safety in the premium for the Office.

A departure in the new century which in my opinion must come, and that soon, is a decrease in the disparity between the market values of policies sold at auction and their Office surrender values. Having regard to the strengthening of the reserves of all Offices the old scales of surrender values are out of date, and, although a few Offices have given the matter proper attention, one has only to look through the Board of Trade returns (sixth Schedule) of the various Offices to note the great variety of modes and bases of calculation of surrender values, and in many cases their obvious inequity to the assured. There has recently been quite a busy market for the sale of life policies at auction, and the prices have been high, probably in many cases on account of special knowledge of the indifferent health of lives assured. The Office in quoting a surrender value usually has no knowledge of the health of the life, and therefore quotes tabular values calculated on the assumption that the life is in good health, but in the same way as under-average lives are rated up for life assurance, and occasionally rated down for life annuities. I can see no reason why in case of surrender the life should not offer himself for examination by the Office, and the surrender value be somewhat increased if found to be in bad health. Apart from this consideration, however, I am not alone in the oft-expressed opinion that the present tabular surrender

values of most Life Offices, especially for policies of long standing on the books, are inequitable to the policy-holder.

Having regard to the recent experience of volunteering for active service at the front in the South African War, to an extent unparalleled in the history of our country, and the probable recurrence of such a wave of patriotism should worse trouble arise, I think it desirable that there should be some common action on the part of the Life Offices as to the extra premium (if any) to be charged for such risks, or the clause (if any) to be inserted in future policies on the subject. In my opinion, if some common basis of action could be arrived at in so important and patriotic a matter, the arrangement would be loyally and faithfully adhered to, but the present difference of practice is most unsatisfactory, causing a great deal of dissatisfaction amongst the assured, and so bringing Life Assurance into disrepute.

Another circumstance which may have an important bearing on the future popularity of Life Assurance is the simplification of policy forms which has recently taken place. A very large proportion of the policies now issued are free of all conditions and restrictions, the only requirement for payment of the sum assured being the due payment of the premium—even the suicide clause being abandoned by about twenty Offices of good standing in this country. So clear and definite a contract must make life policies more marketable and better securities for business purposes, and therefore more appreciated by the public.

The influence I have dealt with—namely, the strain of competition, the rates of interest and mortality, and simplicity of contract—have a most powerful effect on Life Assurance business, and I have given you my reasons for the prevalence in my mind of a more optimistic tone with regard to the tendency of all of them at the opening of this century; but above all these towers the great personal equation—viz., where to find the men in the future to make the most of these advantages; and I think in this respect we also have cause for congratulation.

There is a great demand in the present day for technical education in order to meet the competition of foreign traders, but there is even a higher object than that in cultivating a special knowledge of the principles and practice of our business, namely, to command the respect and intelligent appreciation of those with whom we come in contact in our own business, and secure the confidence of the public from whom our business is obtained.

brought their systems of technical education and research to the greatest perfection, with the result that the chief officers of nearly all the life assurance institutions of the kingdom have the hall-mark of their degree; but the establishment in the provinces, by the Federated Institutes, of machinery for technical training is very significant, and indicates that we may expect in the near future to have our branch officials and outside workers equipped with a sufficient technical training to supplement their personal efforts, for it is still as true as ever that personal industry and intelligent effort are the basis of all our business results, and technical training can be of no avail without these pre-eminent qualities. Our Provincial Managers deserve the warmest thanks and appreciation of Head Office officials for their endeavours to systemise the technical training of gentlemen whose position in the Life Assurance world brings them constantly into contact with the public, and such sound and conscientious work must in due course have a most beneficial effect in future on the progress and prosperity of Life Assurance, and probably be the means of well-deserved promotion to those who take advantage of such valuable opportunities.

H. W. ANDRAS, F.I.A.,
Actuary and Secretary of the Provident Life Office.

Insurance Institute of Newcastle-on-Tyne,
January 21st, 1901.

DAILY QUESTIONS OF LEGAL TITLE.

I BELIEVE it is the practice of many Assurance Companies —and a practice which is justified by wide and mature experience—to refer all, or nearly all, questions of legal title to their Solicitors, and I am far from suggesting that a practice so wise should be abandoned. In the words of one of your Managers of the widest experience and highest standing, who is himself a strong advocate of the practice, it has the incidental advantage that, when a troublesome legal question is put to the Manager by an Assured or an Assignee, he is able to say that it does not fall within his province to deal with legal questions, and that he cannot take the responsibility of doing so. Now, that is a comfortable position for the Manager personally, yet one cannot but admit that, in the stress and strain of competition with rival Companies, the interest of the Manager must be subordinate to that of the Office itself, and that the delay and expense involved in referring to the Solicitors every question of legal title put to the Manager by an Assured or an Assignee must not infrequently result in the loss of business to the Office. Of course, I assume that when a really knotty question of law does arise, no prudent Manager will dispose of it without reference to the Solicitors, upon whom he will rightly throw the burden of its solution (under reservation, no doubt, of his own right to criticise the opinion given); but there are many questions of legal title with which I venture to think —without disrespect to my profession—that the trained Manager is qualified to deal as well as the Solicitors themselves—and, when I say "Manager," I include the Secretary, Actuary, or other official of the Company whose duty it is to deal with legal questions, or to examine deeds presented to the Company by way of title. At some part of his career the Manager has, doubtless, made a regular study of law, and he has access to the standard books of reference, to the periodical Reports, and last, but not least, to the proceedings of Societies such as yours. It is not difficult, however, to understand that, in the pressure of the

many and varied duties which are committed to him, it must be matter of great and increasing difficulty for the Manager to keep himself abreast of all the changes which are constantly being introduced by statute, by legal decision, and by alteration of practice. Even in the standard books it is no infrequent experience for him to find almost every point discussed with irritating fulness, except the precise one with which he has to deal, and to deal immediately, while these books themselves, in no long time after their issue, are driven out of date by the changes I have referred to, and the periodical Reports are not always available to meet the exigencies of the occasion. He may, therefore, be thrown back, more or less, upon the proceedings of Societies such as yours, and, with this in view, I propose to ask your attention to-night to some of the daily questions of legal title which the Manager may be called upon to dispose of, and to notice some changes which have been introduced and points which have been cleared up by recent statute and legal decision. I am well aware that, in doing this, I may be travelling over ground which is already familiar to many of your senior Members, but, if so, I ask their forbearance, on the grounds, (1) that originality, applied to the statement of legal principles, may be highly diverting, but is also highly dangerous; and (2) that I have sought to avoid speculative and theoretical questions, and to deal only with such points of legal title as are of everyday occurrence in an ordinary Assurance Office, in the hope that these notes, fragmentary as they are, may be of some little practical use not only to the senior Members, but also to the juniors, whose experience is less wide, whose opportunities of acquiring a knowledge of legal principles are more limited, but who, after all, are the Managers of the future.

Premising, then, that my notes relate only to Scotch Law, except where the contrary appears, let us take the contract of Life Assurance in regular order from its inception to its ultimate discharge.

Constitution of Contract.

Insurable Interest.

The first question which arises is that of insurable interest involved in the provisions of the Gambling Act,* that there can be no valid assurance on life without an interest on the part of the

* 14 George III., cap. 48.

ing the assurance, and that the assured is not entitled to recover more than the amount of that interest. Thus, a father would have no insurable interest in the life of his son, apart from any relation of debtor and creditor which might exist between them. The application of the principle was the subject of review in two recent cases, viz.:—

I. Hadden's Trustees,* where a policy payable to his heirs, executors, and assignees was taken out by a young man and passed at once into the keeping of his father, who retained possession of it until his death, 25 years afterwards. The premiums on the policy were paid by the father, and in his Will he described it as "The policy of insurance belonging to me on the life of my son," and directed his Trustees to pay the premiums on it until the son's death. In a competition between the representatives of the son and the Trustees, it was held that the policy was the property of the father, and it was observed that the provisions of the Gambling Act merely furnish a defence to the Assurance Company against a claim on the policy; but that, if the Company waive the defence, the question who is entitled to the proceeds of the policy falls to be determined as if the Statute did not exist, and that, as the Assurance Company had paid the money, the plea disappeared.

II. Turnbull & Co.,† where a firm of Merchants had made a proposal for a policy on the life of their Agent in Iceland, through whose means they carried on a lucrative business. The contract of agency (which was disclosed to the Company) was terminable by either party on 1st March of each year, on giving three months' notice. A policy was issued, dated 24th December 1894, containing a note that, as the Assured had stated that they had an insurable interest in the life of the Agent, no further proof of their interest would be required when the policy became a claim. After the proposal was made, but before the policy was issued, the Agent gave notice that he proposed to terminate his contract on 1st March 1895. This notice was not communicated to the Assurance Company. The Agent died on 9th April 1895, and the Company refused payment of the policy moneys, on the grounds that the Merchants had no insurable interest in the life of the

* Hadden's Trustees *v.* Hadden and others, 1899, 36 S.L.R. 525.

† Turnbull & Co. *v.* The Scottish Provident Institution, 1896, 34 S.L.R. 146.

Agent at the date of the policy, and that they had not disclosed his resignation. It was held, however, (1) that, as the contract of agency was not actually terminated at the date of the policy, the Assured had an interest, the sufficiency of which the Company was precluded from denying; and (2) that, as the resignation of the Agent in no way affected the risk, failure to disclose it did not vitiate the policy.

The interest required by the statute is a *pecuniary* interest; but where the relation of debtor and creditor exists, it is not necessary that the debt should be of ascertainable amount, or should be immediately exigible—thus, in the English case of Barnes,* the policy was in the name of the plaintiff on the life of her step-sister, who was a minor. The plaintiff had voluntarily undertaken to educate and maintain her step-sister, and had given a promise to that effect to the child's mother. The policy was held valid on the ground that the Assured had an interest, as creditor, in the life assured, because she had a prospective claim to repayment of the sum she had expended on the child's behalf. The amount of these advances was necessarily uncertain when the policy was effected, but, upon the principle stated, the policy was sustained for the sum assured. Had the Assured been under a legal obligation to support her step-sister, the Court indicated that the policy would have been void, because no claim to repayment would, in that event, have arisen, and the relation of debtor and creditor would not, therefore, have existed.

Terms of Policy. Taking next the Policy itself, its terms and conditions are so familiar, and have, in the normal case, been so carefully considered and so wisely adapted to modern requirements, as to have given rise to little or no recent litigation regarding them. There are a few points, however, of which I may remind you in passing, viz.:—

1. Suicide Clause. That the Suicide Clause has given rise to many interesting questions. As you know, it formerly rendered the policy void (except as regards the interests of *bona-fide* onerous holders) if the Assured should commit suicide at any time, but it is now very gener-

* Barnes *v.* The London, Edinburgh, and Glasgow Insurance Co., 1892, L.R. 1 Q.B.D. 864.

was well illustrated in the experience of one of our Scotch Offices, with whom a Stockbroker in London opened a large policy some years ago. This gentleman had been very successful in business; lived with considerable style in a fashionable part of London; had a charming wife and family; and was, to all appearance, in affluent circumstances. One evening all the family were in Brighton, except the father and a son, who was a student at Oxford but was spending the night with his father in London. The father and son dined together and afterwards played a game of chess. Between nine and ten o'clock, the father said he did not feel well and would go to bed, which he did, first telling a servant to come to his room when he rang. Shortly afterwards the bell was rung, and, on going to the room, the servant was told by her master to give him a dose of medicine from a bottle which she would find on his dressing-table. She did so, and he complained of the nauseous taste of the medicine, but thanked her and said Good-night. In the morning, he was found dead in bed, as the result of poisoning. Two bottles were found on the dressing-table, one containing a harmless medicine which he was in the habit of taking, and the other a poison, which, in the quantity given him by the servant, must certainly prove fatal. It transpired that about this time the Assured had lost large sums of money, and that his affairs were in an embarrassed condition. The bottles had been so arranged on his dressing-table that the servant would naturally take up the one containing poison, without noticing the other. These, and other, circumstances left no doubt in the mind of the Assurance Company that the Assured had practically committed suicide, and had brought in the servant to administer the fatal dose, in the hope that his death would be attributed to misadventure, and that the policy moneys would accordingly be paid to his representatives. The Company was advised that it had a good legal defence to the claim, but the all-prevailing question of expediency came in and the claim was paid. I mention the case as an illustration of the risks to which Assurance Companies are exposed at the hands of unscrupulous policy-holders.

The case of Perkins* was a Sheriff Court case, where the

* Perkins, 1894, 10 S.L. Review, 206.

death were caused by suicide, and they were so held, in circumstances where the Assured was said to have placed a bottle containing carbolic acid in a cupboard beside a bottle containing whisky, and afterwards to have taken the former in mistake for the latter. *Prima facie*, you will observe, there were inherent improbabilities in that suggestion, and it was not given effect to. It was further suggested by the pursuer that the Assured was of insane mind when he took the poison, but it was replied that, if the clause were to be restricted to the case where the Assured commits suicide while of sound mind, it would be of very little use, for the general consensus of medical opinion seems to be that suicide, in the great majority of cases, is a symptom of some form of insanity, permanent or temporary, in which the emotions or passions are excited or perverted. It was pointed out, moreover, that the claim would be barred by the principle that no one can give or take benefit by his own criminal act, which suicide, by a person of sound mind, would be. It is to be observed that suicide, in the sense of the policies, meant self-murder, not merely self-killing, which might, of course, be either accidental or intentional.

2. Duration.

That a Policy from one day certain to another day certain, covers the whole of the latter and none of the former. Thus, in the case of the Sickness and Accident Assurance Association, Ltd., *v.* The General Accident Assurance Corporation, Ltd.,* the Corporation agreed to insure against accident for twelve months, from 24th November 1888 inclusive, but stipulated that no insurance should be effected until the premium was paid. An accident occurred *on* 24th November, before the premium had been paid. On 26th November the premium was paid and the Corporation acknowledged receipt of it as premium for the risk "from 24th instant." In an action raised against the Corporation by the Association, which had paid the loss, for contribution, it was held that the preliminary contract to grant an insurance to cover the *risk* of accidents on 24th November, on payment of the premium, was not binding after the accident had occurred, because

* Sickness and Accident Assurance Association, Ltd., *v.* The General Accident Assurance Corporation, Ltd., 1892, 19 R. 977.

which was not the subject of insurance. It was remarked that the primary meaning of "from the 24th" is from the expiry of the 24th, and excludes that date; and Lord Adam observed:—"Suppose an Assurance Company had agreed to insure the life of "an individual, but that, before the premium had been paid or the "policy issued, he had died, I do not think the Company would "be bound to accept the premium and complete the transaction."

The importance of this question of time was illustrated by another case which occurred in the experience of one of our Scotch Offices, where a Merchant in London opened a policy upon his own life and paid a year's premium, which carried his insurance up to twelve o'clock p.m. on the night of 31st October. That night he retired about ten o'clock, apparently in good health, but next morning, between eight and nine o'clock, he was found dead in bed. The body was not yet cold, and the question arose whether he died on 31st October or 1st November. In the former case he was assured, in the latter he was not. The circumstantial evidence was all in favour of the Assurance Company's view, that he died on 1st November, but here the question of expediency again came in, and, with the liberality which is characteristic of a wisely conducted Office, the Company paid the claim and refused to stand upon its legal rights.

3. Ambiguity. That, in the construction of a policy, the rule is well established that, where there is ambiguity of meaning, the most favourable view to the Assured is to be preferred.*

4. Proposal and Acceptance. That where the proposal form provides that, if the risk be accepted, the proposer shall pay the premium when due, it has been held in a recent English case† that the proposer is not entitled to decline to proceed with the insurance, but must pay the premium. In that case, the defendant agreed that the proposal and declaration should be the basis of the contract between him and the Corporation and that, if the risk were accepted, he would pay the premium, when called upon to do so. The policy was

* Standard Life Assurance Co., 1884, 11 R., H.L. 48, per Lord Watson, pages 53-54.
†General Accident Insurance Corporation *v.* Cronk, 31st January 1901, 17 Times Law Reports, 233.

executed and the plaintiff's agent took it to the defendant, who ultimately stated that he did not desire to proceed with the insurance. It was argued for him that, although the proposal was an offer on his part, the execution of the policy was not an acceptance thereof, because it was not drawn in terms which precisely met the proposal, but contained some provisions which did not appear in that document, and which, therefore, required acceptance by the defendant to make the contract complete. It was held, however, that he must be taken to have applied for the ordinary form of policy issued by the Company; that, if a wrong form of policy were tendered to him, he might refuse it; but that this would not relieve him from the obligation to accept the policy for which he *did* apply, or to pay the premium.

5. Stamps. That the Stamp Act* imposes a penalty on anyone who receives or takes credit for a premium, and does not, within one month, make out and execute a duly stamped policy. The stamp of the policy presents no special difficulty, but on the question of stamps generally, I refer to the Appendix, in which I have brought together a few notes on some of the stamp-duties which the Examiner will most frequently have to consider. Of course, the heads in the Appendix are intended to be read along with the corresponding heads in the Act itself.

6. Place of Payment. There is a subsidiary point, which I mention simply because I have seen it raised in practice, viz.:—That where the place of payment of the policy moneys is not specified in the policy, the Company is sometimes asked to pay the dues of remitting these moneys to the place where the representatives of the Assured reside, and where, possibly, the arrangement for the assurance was originally made. It seems desirable to avoid even this cause of friction between a policy-holder and the Company, by providing a place of payment in the policy itself, although this is not always done.

Transmission of Contract.

Now we come to some of the methods by which policies are transmitted from one living person to another.

*Stamp Act, 1891, § 100.

1. Absolute Assignation. course, the absolute Assignation, by which the Assured transfers the policy, with all the benefits which it confers, by way of bonus or otherwise, to the Assignee, who, upon intimation of the Assignation to the Assurance Company, becomes vested with the title to the policy to the exclusion of the Assured. But here the question arises—What are the points which must be kept in view by the official who examines the deed on behalf of the Company?

1. Date and Signature. First of all, the Examiner must see that the deed is properly dated and that it is signed by the granter and two witnesses, or that it is holograph (*i.e.*, written in the granter's own hand), or that it is adopted by him as holograph. If the granter be blind, or suffering from sickness and bodily weakness, and cannot write, it may be signed for him by a Notary-Public or Justice of the Peace, before two witnesses, in the form which you will find appended to the Conveyancing (Scotland) Act, 1874, Schedule I. But what if the granter be blind, yet *can* write? It has been decided that a blind person, who can sign his name, may legally do so; but, if he choose, he may execute his deed notarially. The better practice, in the case of a blind person, who can write, is to have the deed executed both by himself and by the Notary or Justice of the Peace. I have heard it argued by Solicitors of high standing, that the Act of 1874 does not apply to the case of a blind person who *can* write, and that, therefore, the appropriate form of notarial execution for him requires two Notaries and four witnesses, according to the practice prior to 1874, but I think this view is now generally discarded. I should add, that signature of an Assignation by mark is not sufficient.

2. Effect. The Examiner must see that the deed is really what it purports to be, *i.e.*, that it contains effectual words of assignation, and correctly describes the policy assigned—for what we must regard is, not what the deed is called, but what it actually is. It must, therefore, use words which are appropriate to carry out the object it is intended to effect. Happily, the tendency of modern practice seems to be all in the direction of simplicity and brevity in the phraseology of legal documents, so that they

ordinary intelligence can understand them. In my view, there is still room for improvement, but it is something to be thankful for that the day seems fast going by, if it has not already gone, when lawyers thought it necessary to swathe even the simplest proposition in a mass of legal verbiage which came near to serving that purpose of language which is intended to conceal thought; when they did not sell and assign a policy, but "sold, "alienated, assigned, transferred, disponed, conveyed, and made "over" the same; and when "Punch," with just sufficient truth to give point to its irony, framed the Summons in an action of damages for sheep-worrying as follows:—"The said dog did attack, "bite, injure, hurt, chase, worry, harass, tear, agitate, wound, "lacerate, snap at, and *kill* the said sheep and lambs, whereby "they were greatly terrified, damaged, injured, hurt, deteriorated, "depreciated, frightened, floored, flurried, flustered, and flabber-"gasted, to the damage of the plaintiff of £250, and therefore he "brings this suit." In England the practice is gradually becoming more general of writing deeds in book form, upon paper, instead of upon those parchment horrors, for the perusal of which one required the properties of a kind of derrick crane to swing round the long lines and to turn over the enormous leaves. But the exigencies of modern business demand promptitude and despatch; men have grown tired of the redundancy and tautology of our older forms; and I believe there are few right-minded lawyers who would seek to impede the improvement which the tendency I have mentioned will lead to. But this is by the way.

If the Assignation contain any qualification or restriction upon the right of the Assignee to the full benefits of the policy, this must be carefully observed and given effect to. The deed may, for instance, contain some limitation upon the Assignee's right to uplift and discharge the policy moneys, although, if not, this power will be implied.

Bonuses.

A question has been raised as to whether it is necessary, to carry bonuses, that they should be expressly assigned, but, upon the footing that the accessory follows the principal, it is considered that the bonus accruing upon a policy, which the holder has not elected to apply in reduction of premiums prior to the Assignation, passes to the Assignee, although not expressly assigned.

3. Stamp Duties. true consideration for which the deed was granted, because upon this depends the material question of Stamp-Duty. I remind you that, by Statute, it is provided that an Assignment is ineffectual unless duly stamped, and that the Company is placed under penalty if it make any payment in contravention of this provision.*

Price.

Now, if an absolute Assignation be granted, in consideration of a price paid by the Assignee to the Assured, the case is simple, because there, the stamp-duty is found under the heading "Conveyance on Sale" in the Stamp Act of 1891, and is, roughly speaking, 10s. per cent. on the price; but what if the deed be granted, as deeds frequently are, in consideration of "the love, favour, and affection" which the granter bears to the grantee? Well, the appraisement which the Legislature seems to have placed upon these emotions is, that they never exceed £100 sterling in value, for the stamp duty is invariably 10s. What, again, if the consideration be the very common one, viz.: — "For certain good and onerous causes and considerations"? For many years this was a vexed question, and was a fruitful source of wrangling among lawyers. On the one hand, it was maintained that the deed does not in itself give sufficient information to determine what the real consideration is; that it is generally qualified by a Back Letter or other document setting forth the true nature of the transaction, of which the Assignation forms only a part; and that it is the duty of the Examiner to call for production of that Letter or document, so that he may see that the Revenue has obtained the full amount of duty which is chargeable upon the true consideration. On the other hand, it was maintained that the General Deed stamp of 10s. is the full sum which, *ex facie* of the deed itself, is required, whether there be a Back Letter or not, the deed being a Conveyance or Transfer of a kind referred to in the Stamp Act† as "Conveyance or Transfer of any kind not hereinbefore described"; that the

Love, Favour, and Affection—

For Certain Good and Onerous Causes.

* Stamp Act, 1891, § 118.
† Stamp Act, 1891, § 54.

only deed with which the Examiner is concerned is the Assignation, and this being *ex facie* duly stamped, there is no right, and still less any duty, on his part, either to impute fraudulent misstatement of the consideration, or to enquire into the proper stamp of a document which does not come before him, so that his only prudent course is to refrain from making any such enquiry; that, while it is true that a Back Letter granted with reference to such a deed may be chargeable, for instance, with Mortgage duty, yet it forms no part of the title proper, although it may materially affect personal questions between the holder of the Assignation and the granter or anyone representing him; and that, as the Assignation gives the Assignee a good title, a purchaser, or other person dealing with him, is not concerned with such questions. I think it may now be taken that the latter is the better opinion, and that deeds granted "for good and onerous causes and considerations" may be passed as duly stamped, without further enquiry, if they are impressed with the duty of 10s.

Marriage Contracts.

What, again, is the duty chargeable in respect of Marriage Contracts? This question depends for its solution upon the settlements which the Contract contains, but, as these may be very complex, and the Contract may be chargeable with duty under several heads, it will be a safe rule for the Company to adopt, that they should either refer the deed to their Solicitors, or insist upon Adjudication of the stamp-duty, except in the simplest cases.

Adjudication.

Now, as to this Adjudication, cases will frequently arise in which the Examiner may have reasonable doubt whether a deed is duly stamped, and, where the parties refuse to give him the information necessary to enable him to satisfy himself on this point, it is open to him to refuse to register the deed or make payment of the policy moneys, unless the deed bear the Adjudication stamp of the Inland Revenue, which can be obtained by the parties interested, on presentation of the document to the Solicitor of Inland Revenue in Edinburgh, along with an Abstract thereof and a Schedule of Application for the Adjudication stamp.

Upon other questions of stamp-duty arising under this head, I refer to the Appendix, and would only add that, while formerly it was not an unusual practice for an Assurance Company, where a

person receiving the policy moneys to keep the Company free of any responsibility consequent upon the absence or insufficiency of stamp-duty on a deed forming part of the title, it is now provided by the Stamp Act* that every such undertaking in respect of any document executed after 16th May 1888, shall be void.

Gratuitous Assignations.

Before leaving the question of Consideration, let me add a word of warning regarding Assignations not founded upon valuable consideration. The principle underlying the Law on this subject is that a man must be just before he is generous. A person who is indebted is not entitled to give away — that is, to assign without any equivalent — what is in truth not his own but his Creditors' property. The true criterion is, Does the Assignation subtract from that property which is the proper fund for payment of the granter's debts, an amount without which these debts cannot be paid? If it does, the inference is that the Assignation is fraudulent; but if the granter has, at the date of the Assignation, property left in tangible assets, outside the Assignation, amply sufficient to meet all his existing debts and liabilities, the Gratuitous Assignation (or Voluntary Assignment, as it is called in England) may not be struck at, even though the granter may be temporarily embarrassed. This question frequently arises in the case of Assignations by Post-Nuptial Settlement. Thus, suppose a man in a state of insolvency or about to embark in a hazardous business were to settle all, or substantially all, his property by way of Post-Nuptial Settlement on his wife and children, with a view to put it beyond the reach of his Creditors or to avoid the risk of the adventure, and were thus to denude himself of his property, the inference would be almost irresistible that he meant to defeat his creditors. Still the onus of proving fraud, where the granter is not indebted at the time, would be thrown on those who impeach the Assignation, for fraud is not to be presumed, and the Examiner will keep in view that it is no part of his duty to attribute fraud, but only to proceed with caution where he is acting in reliance upon a Deed which is

* Stamp Act, 1891, § 117.

attended by suspicious circumstances such as I have referred to. As to Ante-Nuptial Contracts, the Law, rightly or wrongly, regards marriage as a valuable consideration, but a Settlement executed on marriage may still be fraudulent, if the intention of the parties be to defraud and delay creditors and the marriage be merely part of a scheme for that purpose, as it was in a reported case.

Now we have seen generally what are the various points to be kept in view by the Examiner with regard to Absolute Assignations in the normal case; but, of course, he will find that he is almost daily called upon to deal with cases which are *not* normal, and in which the deeds presented to him are defective in some one or more of the points we have considered. Here I can only suggest to him that, while he must keep steadfastly before him what is essential, he should avoid raising objections which, although technically sound, are substantially frivolous. The interest of his Office must be his first consideration, and a too rigid adherence to the letter of the law may well be prejudicial to the popularity of his Company, by leading Policy-holders to suppose that their money is being unduly withheld, and otherwise. He must aim at a wise discretion in the position he takes up; and, in the exercise of that discretion, he will usually have regard to such circumstances as the amount, small or large, involved in the question at issue, and the desirability of interposing no theoretical obstacle to a settlement which, in form, may be attended by some irregularity, but, in substance, affords practical and adequate protection to the Office. If he should have any doubt or difficulty in determining what is essential and what is not, he should refer the question to the Solicitors of the Company.

Notices.

At this point we may conveniently deal with the Notice which, on the completion of the Assignation, it is essential to give to the Company. This is usually done in the familiar form prescribed by the Policies of Assurance Act of 1867. As you know, Section 3 of that Act requires written notice of the date and purport of the Assignation to be given to the Company, and the date on which such notice is received regulates the priority of claimants under Assignations. But what constitutes written

legal decision on that point, but it is thought that intimation may be given either by the usual duplicate Notice or by transmitting to the Company a copy of the Assignation in terms of the Transmission of Movable Property (Scotland) Act, 1862, Section 2. By the latter method, as well as the former, the Company would receive intimation of the date and purport of the Assignation, which is all that is required by the Act. The priority of notice referred to in the third Section of the 1867 Act only applies to questions with the Company, and questions of priority among Assignees themselves are determined by the Common Law.

Where no Deed Executed.

It sometimes happens that Notice of the Assignation is given to the Company; and, on subsequent dealings with the policy, it is stated that the transaction was never carried out and no such deed was executed. What is to be done in these circumstances? If the Notice be of recent date, a letter may be taken from the person giving the Notice, certifying that the deed in question never existed. But suppose the Notice were given twenty or thirty years ago, and it is now impossible to trace the person giving it? In these circumstances, it would appear that the Company's safe course is either (1) to take a Statutory Declaration from all the parties interested, setting forth the facts as to the transaction, along with a satisfactory Indemnity against any further claim in respect of the policy, and to pay on production of the policy discharged by the person otherwise entitled to it; or (2) to leave the matter to be settled by an action in Court, in which the Company would admit liability to pay on production of a clear title, and would, in the ordinary case, obtain its expenses.

Where no Re-assignment.

Again, a policy is assigned to a Creditor; but, on the debt being paid, no Re-assignment is taken, or, if taken, has been lost, and the original Assignee is dead or has disappeared. Here, if the person whose title is otherwise complete be responsible and of good financial standing, the matter may be dealt with in the same way as that suggested where no deed has been executed —viz., by Statutory Declaration and Indemnity. The Declaration may mention incidentally, in the case of a missing deed, that it was

properly stamped; but it is to be kept in view that the presumption of law is that a lost instrument was duly stamped, in the absence of some evidence to the contrary.* If, however, the transaction be a recent one, the Company will probably think it prudent to let the matter be decided by way of action in Court.

Can Notice be Cancelled?

Again, can a Notice of Assignation be cancelled by the person giving it, or must the deed it refers to always remain as part of the title? This case sometimes arises where the original deed has not been stamped within the proper time, and in order to get over the difficulty a fresh deed is executed. I believe an opinion has been obtained by the Life Offices' Association that this procedure is an evasion of stamp-duty and incompetent—the reason being, I take it, that the first deed is really effectual to divest the granter of his right to the policy (although it requires to be completed by stamping, which may be done at any time), and that, therefore, there is no title left in him to be assigned by the second deed. If, however, the second deed be executed and notice thereof be given, it also will have to be stamped, and will thenceforth be part of the title. I understand that, in one case, the Revenue have, on presentation to them of a proper Memorial setting forth the facts of the case, allowed the Notice to be cancelled, so far as they were concerned, and abandoned their claim to penalty, but this should not be taken as a general sanction to such a practice.

II. Securities.

The next method of transmission of policies, which we may shortly notice, is that by Bond and Assignation in Security (which we may, for brevity, refer to hereafter simply as "Bond"), or Mortgage, as it is called in England. The admirable security afforded by a policy for the amount of its surrender value, which is gradually increasing, and the many cases in which the personal obligation of the borrower, fortified by a Life Assurance, affords precisely the kind of security required by a lender, render this form of transmission exceedingly common. Now, what are the points which the Examiner must keep in view in connection with these deeds?

* Marine Investment Co. *v.* Haviside, 1872, L.R. 5, H.L. 624.

Signature.
(1) Effect.
Consideration.
Notice.

I have already made regarding the date, signature, effect, consideration, and notice of an absolute Assignation, which, with the obvious modifications, are also applicable to Bonds.

(2) Power to Discharge, Sell, Surrender, and Borrow.

The Examiner will consider whether the deed contains a power to discharge the policy moneys, because, although this power is implied in England under the Conveyancing Act of 1881, that Act does not extend to Scotland, and the clause should be expressed in Scotch Bonds. Again, if the Mortgagee is to have power to sell, surrender, or borrow upon the policy, these powers must be expressly conferred by the deed. Sometimes the policy itself contains a clause to the effect that the holder of the policy, as Mortgagee or Trustee, may surrender it, and a surrender made in terms of such a clause would, of course, be effectual.

(3) Stamp.

The Examiner will consider whether the deed is properly stamped, and, for questions arising under this head, I refer to the Appendix.

Equitable Mortgage.

In connection with the subject of securities, let me add that it is freqnently laid down as an absolute proposition of Scotch law that incorporeal rights, such as debts, assurance policies and the like, cannot be transferred otherwise than by Assignation, duly intimated; but this principle, so far as assurance policies are concerned, must be received with some reservation in the light of two recent cases, the effect of which was to show that an effectual security may be constituted over a Scotch policy in England or Ireland by the mere deposit of the policy, followed by intimation to the Assurance Company by letter, without any Assignation at all, and that, upon such a title, the Company will be bound to pay, viz.:—

1. The Scottish Provident Institution,* where a domiciled Scotchman obtained a loan in England from a money-lender there, and in security thereof delivered to the latter a policy on his life with the Scottish Provident. The Borrower died, and, after his

The Scottish Provident Institution v. Cohen & Co., 1888, 16 R. 112.

death, the Lender gave notice, by letter, to the Assurance Company that the policy had been assigned to him and was in his possession. Thereafter, the estates of the deceased were sequestrated and a Trustee appointed. In a competition for the policy moneys, between the Money-lender and the Trustee, it was held—(1) that, the transaction having taken place in England, the rights of the holder fell to be determined by the laws of that country; and (2) that, upon an admission by the parties as to the law of England, the deposit of the policy and the intimation to the Company were effectual to confer a preference upon the holder of the policy, the Money-lender. The grounds of decision were that there is a valid right of credit in the policy-holder, distinct from the contract constituted by the policy itself; that this right of credit follows the domicile of the creditor, wherever he goes; that it is capable of assignment by him; that the validity of the Assignment will, in general, be determined by the *lex loci contractus*, that is, according to the law of the country in which the transference is made or the security given, and that the intimation by letter put the Company in the same position as if a Scotch Assignation had been intimated to it of the same date. The Assignment of an English policy, by way of deposit made in Scotland, would not, of course, be recognised by our law, but the English law is different.

II. The Scottish Provident Institution,* where a domiciled Irishman assured his life with the Scottish Provident and deposited the policy with a creditor, also a domiciled Irishman, in security of a debt. Subsequently he executed in Ireland an Assignation of the policy in favour of another creditor, also a domiciled Irishman, and this Assignation was intimated to the Company, who had, at that time, no knowledge of the deposit of the policy. The Assignee, at the time he took the Assignation, knew that the policy had been deposited with the first creditor. The Assured died, and a competition for the policy moneys arose in the Courts of Scotland, between the Depositary and the Assignee. It was held that the validity of the transference must be determined by the law of Ireland; and, after an admission as to that law, that the Depositary must be preferred. The admission was that, by the law of

* The Scottish Provident Institution *v.* Robinson and Newett, 1892, 29 S.L.R. 733.

a loan advanced on the faith of such deposit, or in security of sums due at its date, operates as an Equitable Mortgage in favour of the lender or creditor, which will be preferable to the right of the person acquiring right by a subsequent Assignation, if such subsequent Assignee have notice of the deposit. It was pointed out by the Depositary that it approached absurdity to say that, in a transaction concluded in Ireland by Irishmen, the law which the parties had in view was the law of Scotland.

III. Bankruptcy. The next mode of transmitting the policy arises through bankruptcy or insolvency, *e.g.*, of the Assured, the Assignee, or the Bondholder. Now, what are the documents which the Examiner must see in this case? As you know, a bankruptcy may take various forms, viz.:—

(1.) Sequestration. Sequestration, which is a process for the attachment of an insolvent debtor's estate, and its rateable distribution among his creditors. It is applicable to the estate of even a deceased debtor, and it affects *acquirenda*, that is, property acquired by the bankrupt after Sequestration, but prior to his discharge by the Court. The Act and Warrant of Confirmation issued by the Sheriff to the Trustee is the document which transfers to and vests in him the whole property of the debtor, including assurance policies, and all other property in which the bankrupt has a beneficial interest, subject, of course, to such preferable securities as exist at the date of the Sequestration. The Trustee's title requires no procedure by way of delivery or intimation to complete it, Sequestration being held to be a public fact known to all. How hardly this principle may operate against an Assurance Company is illustrated by a recent case* where the facts were as follows:—In 1873, Fairley assured his life with the Scottish Union and National Insurance Company for £100. In 1888, his estates were sequestrated under the Bankruptcy Acts, and a Trustee was appointed. Fairley did not disclose to the Trustee that he had assured his life, and the Trustee was not then aware of the existence of the policy. A first dividend was paid to the creditors,

* The Scottish Union and National Insurance Co. *v.* Fairley, 19th July 1900, unreported (Lord Low).

but nothing further was done in the Sequestration, and neither the Trustee nor Fairley obtained his discharge. In 1898, Fairley obtained a loan of £45 from the Company, on the security of the policy. In 1899, he died, and his widow obtained from the Trustee an Assignation of the policy, in consideration of a payment of £5. The proceeds of the policy were accordingly claimed by Fairley's widow, and also by the Company to the extent of the loan they had made to Fairley, with interest. It was held that the claim of the widow must prevail, and the ground of decision was, that by Sequestration the policy was vested in the Trustee to the same effect as if it had been assigned to him and the Assignation had been duly intimated. The Company replied that they were not aware that Fairley was bankrupt, and that they advanced the money in good faith. This, although admitted, did not make any difference, because Sequestration is a public matter of which ignorance cannot be pleaded. The Company further claimed right to retention of so much of the proceeds of the policy as was required to pay their debt; but it was held that the right of retention could only be claimed if the counter-debts or obligations existed at the date of the Sequestration, and here the debt of the Company did not arise until ten years after the Sequestration. A plea of personal bar against the widow was also repelled. The effect of the judgment was that the Company lost the amount of their loan, with interest, and had to pay the full policy moneys to the widow, as Assignee. I assume, although it is not stated, that in his proposal for the loan, Fairley did not disclose his bankruptcy, in answer to the usual question on that subject, but it occurs to me to point out that, while this might have rendered him liable to a prosecution for fraud, it could not affect the legal title to the policy, which had vested in the Trustee prior to the loan, and was duly transmitted to the widow.

It is true that, by the Bankruptcy Act of 1856,* it is provided that "if a debtor, in ignorance of the Sequestration, have paid his "debt *bona fide* to the bankrupt, he shall not be obliged to pay it "a second time to the Trustee." But this does not justify the general statement, which I have seen made, that if a debtor makes *a payment* to the Assured, in ignorance of the Sequestration, he cannot be required to pay over again to the Trustee. That statement appears to me too wide, because (1) the provision

* Bankruptcy Act, 1856, § 111.

the Confirmation of the Trustee operates as an intimated Assignation of the movable estate and effects of the bankrupt,* and the provision would, therefore, be strictly interpreted by the Court; (2) applying that interpretation to the words used, only *debts* due to the bankrupt are protected; and (3) it is obvious that a *loan* to the bankrupt is not a debt due to him, and is not, therefore, protected—indeed it might be a question of circumstances whether a surrender value would be regarded as a debt. Again, it is only payment of debt *to the bankrupt* that is protected; but what if payment of the policy moneys has been made to his Executors or Assignees, whose title has been intimated to the Company after his estates have been sequestrated? And, further, it is only against a second payment *to the Trustee* that the debtor is protected. But what if the Trustee have assigned his rights to an Assignee for a full price? The plea of *bona-fide* payment under the Act does not appear to have been raised in Fairley's case, but, even if it had, I think it would have been unavailing, for the reasons I have stated.

In view of the far-reaching and important effects of bankruptcy, so far as Assurance Companies are concerned, I venture to think that some method must be devised whereby Companies doing business in Scotland may protect themselves against the risks involved in bankruptcy, as illustrated by the case I have just quoted. This, probably, is an administrative question, which each Office will decide in its own way, and whether the method adopted be by a Register, which might be kept by a competent clerk at the Head Office, and in which might be entered (1) in alphabetical order, the names of every policy-holder, assignee, or other person interested in the Company's policies, whose bankruptcy might affect the title, and (2) a note taken from the weekly Gazettes of any bankruptcy notice affecting these persons; or whether some other and simpler method be adopted, the question appears to be one to which Assurance Companies must carefully address themselves. No doubt the registration method is open to many objections, on the ground of labour, expense, incompleteness as regards old policies and old bankruptcies and otherwise, but, even if it be begun now and relate only to bankruptcies which occur hereafter, it might, I think, prove a

* Bankruptcy Act, 1856, § 102.

its disadvantages.

(2) Cessio Bonorum. *Cessio Bonorum*, which is a minor process for the distribution of a bankrupt's estate, similar in its leading features to Sequestration, and appropriate to estates of small amount, where the process of administration and distribution is comparatively simple, and the more elaborate machinery of Sequestration is uncalled for. In other words, it confers a cheap and speedy method of supplying the place of Sequestration in small bankruptcies. Where the liabilities of the debtor exceed £200, the Sheriff has a discretionary power to award Sequestration; but this does not mean that Cessios are limited to estates in which the debts do not exceed that amount, but only that the Sheriff *may* award Sequestration, where they exceed it. The Extract Decree of Cessio issued by the Sheriff is the document which proves the Trustee's title; and the Decree is effectual from its date to vest the movable estate in the Trustee, without the necessity for intimation or possession following thereon.* It ordains the bankrupt to grant a Disposition *omnium bonorum* in favour of the Trustee, who has been appointed by the Sheriff. While the Decree operates as an Assignation of the debtor's movables, including policies of assurance, the heritable estate only passes to the Trustee under the Disposition when executed. Where there is no heritable estate, the Disposition is usually dispensed with. Cessio does not affect *acquirenda*, although these may be attached by individual creditors in the same way as if the Cessio did not exist.†

(3) Trust Deed. Trust Deed for Creditors, by which the debtor conveys his estate to a Trustee, in order that the latter may hold it against the granter for behoof of his creditors, and for distribution among them towards satisfaction of their claims. It is in fact another way of handing over the estate to the creditors—to convey to them direct being theoretically possible, but not reasonably practicable, where, as usually happens, they are numerous. This is, of course, a voluntary deed to which the creditors are not bound to accede, and it may be superseded by Sequestration, but considerations of economy, as well as a frequent willingness to save the debtor from public bankruptcy, render this method of

* Gray *v.* Gray's Trustee, 1895, 22 R. 326.

† Reid *v.* Graham 1894, 31 S.L.R. 779.

must be completed by intimation in the case of policies and debts. The Trust Deed itself is, of course, the evidence of the Trustee's title, and it is his duty to obtain possession of the estate conveyed to him, so as to exclude arrestments and other diligence at the instance of the creditors.

Collateral Titles.

Now, there are various documents that may be presented to the Examiner, which, while they are not Assignations in form, are yet links in the title which justify the holder in dealing with the policy. Such, for instance, are the titles of Judicial Factors.

(1) Judicial Factors

As you know, a Judicial Factor is an Administrator appointed by the Court of Session or Sheriff Court, to whose care, under the supervision of the Court, are intrusted estates and interests without a capable owner or administrator, or which are matter of litigation, to the end that the same may not suffer in the meantime. Thus, he may be appointed where, for example, a father has died without a Settlement, leaving a child in pupillarity who has no other legal Administrator, in which case the Factor is called a Factor *loco tutoris*; where a person resident abroad has succeeded to estate in Scotland, in which case the Factor is called a Factor *loco absentis*; where from insanity, mental incapacity, extreme age, or even severe indisposition, a person has become incapable of managing his own affairs, in which case the Factor is called a *Curator Bonis*; where Trustees named by a person deceased have declined to accept, or have died, or have become incapable of acting, or been removed, in which case the person appointed is called a Judicial Factor. Now, in all these cases the title of the Factor will be proved by the Extract Decree of his appointment by the Court. Generally speaking, a Judicial Factor may be appointed by the Sheriff Court to act *loco tutoris* or as *Curator Bonis* upon estates which do not exceed £100 in yearly value.

(2) Factors and Commissioners.

Next, we may have the title of a Factor and Commissioner or Attorney. A Factory and Commission, or, as they call it in England, a Power of Attorney, is a deed by which one person empowers another to act for him, or exercise rights in his place, and it may be either (1) General, conferring only ordinary powers of administration, (2) Special, authorising only

powers and special powers which would not otherwise have been included. The Examiner must carefully note (1) that the deed gives the Commissioner or Attorney the power which he proposes to exercise in dealing with the Assurance Company on behalf of the granter; and (2) that it is in full force at the date of the transaction. The Factory or Power is terminated by the death or bankruptcy of the granter, as well as by recall, resignation, and expiry of the time fixed for its continuance, if any.

(3) Liquidators.

Next, we may have the title of a Liquidator, who is an officer appointed to conduct the winding up of a Joint Stock Company. He is appointed by the Company in the case of a voluntary winding up, and by the Court in the case of a judicial winding up. In the case of a Voluntary Liquidation, the Liquidator is appointed (1) by a Special Resolution of the Company, passed at a General Meeting of the Shareholders, and confirmed at another General Meeting held not less than fourteen and not more than thirty days after the first, or (2) by an Extraordinary Resolution passed at a General Meeting of the Shareholders, to the effect that it has been proved to their satisfaction that the Company, by reason of its liabilities, cannot continue its business, and that it is advisable to wind up the same. In either case, notice of the Resolution must be given in the Edinburgh Gazette. The Liquidator's title will consist of (1) a copy of these Resolutions, certified by a responsible official, usually the Chairman of the Meetings at which they were passed, and (2) the Gazette, or a certified excerpt therefrom, containing the Notice. In a Voluntary Liquidation continued under the supervision of the Court, the Voluntary Liquidator will continue to act without the sanction of the Court, unless the Supervision Order impose restrictions upon his liberty of action. The Liquidator appointed by the Court may be either (1) a "Provisional Liquidator," who is merely a temporary officer appointed to *protect* the assets of the Company, on grounds similar to those on which a Judicial Factor may be appointed on a bankrupt estate, or (2) an "Official Liquidator," who is the officer subsequently appointed and has the actual management of the winding up.

Voluntary Liquidator.

Provisional Liquidator.

Official Liquidator.

You will produce as his title the Order of the Court sustaining his appointment.

IV. Death.

Now we come to the transmission of policies from the dead to the living, and I need hardly remind you that the proper title to be produced to the Company is the Confirmation or Warrant issued by the Sheriff, entitling the Executor to uplift and administer the movable estate of the deceased, as contained in the Inventory on which the Confirmation proceeds. Except in the case of an Executor Creditor, the Confirmation must be of the whole movable estate of the deceased, and, if part be omitted, the Executor must take out an additional warrant or Eik to his Confirmation. The Executor's discharge is only valid to the extent of the sum to which he has been confirmed, and the debtor is not safe in paying a larger sum. Formerly, Confirmations were issued in some Sheriffdoms without any Inventories attached, so that one could not tell what were the individual items included in it, such, for instance, as policies of assurance, but it was considered that the Company would be in safety to pay the Executor an amount not exceeding the slump sum to which he was confirmed. Now, however, by the new Executors Act* it is provided that the Inventory *must* be embodied in, or attached to, the Confirmation. By the same Act, a change of practice which was long considered desirable has received statutory sanction. Where the sole or last surviving Executor, who was himself interested in the estate, died after Confirmation, but before obtaining possession of the whole estate, the estate passed to his Executors, and practically all Executors-dative were held to have been confirmed for their own interest; but if the sole or last surviving Executor-nominate, who had himself no interest in the estate, was confirmed for behoof of others, the estate did not vest in him until he had actually obtained possession of it. His Confirmation lapsed on his death, and it was necessary that a new Executor should be confirmed *ad non executa*, and the new Executor's Confirmation applied to

Confirmation.

Eik.

Inventory.

Death of Executor.

* Executors (Scotland) Act, 1900, § 5.

that part of the estate which was not realised by the original Executor. By the new Act,* however, it is provided that, when any sole or last surviving Executor-nominate has died, with funds in Scotland standing in his name as Executor, Confirmation by his Executors-nominate to his proper personal estate shall, whether granted before or after the passing of the Act, be valid and available to such Executors for recovering such funds, provided a statement thereof shall have been appended to the Inventory. Where one of two or more Executors dies, the office accrues to the survivor or survivors, and Executors, like Trustees, may act by a majority of their number as a quorum.† It is important for the Examiner to observe whether any Executor is appointed a *sine quo non*, so that, if need be, any discharge to the Company shall have his signature or consent.

Survivorship and Quorum.

Where no one comes forward to take out Confirmation as Executor, it is open to any creditor of the deceased to be confirmed as Executor-Creditor to so much of the estate as will enable him to make good his debt, and it is to be observed that Confirmation as Executor-Creditor is preferable to Arrestment, although the Arrestment be prior in date, because Confirmation has the effect of completed diligence, whereas the Arrestment, until followed by a Decree of Furthcoming, is incomplete.

Executor Creditor.

In the case of persons dying domiciled in England or Ireland, the Probate or Letters of Administration granted in these countries, and bearing that the deceased died domiciled there, must, in order to be effectual in Scotland, be produced in the Commissary Court at Edinburgh, and a copy thereof lodged with the Commissary Clerk, who thereupon endorses the principal document to the effect that it has been produced and a copy deposited. The Probate or Letters have then the like effect as if Confirmation had been granted in Scotland; and it is essential for the Examiner to see that these formalities have been observed, unless, of course, his Company has a special Act of Parliament in which they are dispensed with

Probate.

* Executors (Scotland) Act, 1900, § 6.

† Executors (Scotland) Act, 1900, § 4.

Foreign Grant of Representation.

Now there comes a question which has given rise to a good deal of diverse opinion, and which remains, so far as I am aware, unsettled by any legal decision. I refer to the question whether it is necessary for the Assurance Company to insist upon production of a Grant of Representation (Confirmation Probate or Letters of Administration) from a Court in the United Kingdom, in the case of persons dying domiciled abroad. By the Revenue Act of 1884* it was provided that production of such a Grant should be necessary, subject to certain provisos therein contained. By the Revenue Act of 1889† it was provided that production of such a Grant should *not* be necessary to establish right to receive the money payable in respect of the policy. Notwithstanding this provision, it has been argued that, under the Finance Act of 1894, the Company is bound to see that Estate Duty has been paid in respect of the Policy, and that this involves the production of a Grant of Representation. This view appears to proceed upon a confusion between the title which requires to be produced to the Company, and the payment of the Estate Duty by the representatives of the deceased. The true view seems to be that the Company is a mere debtor under its policy, and not, therefore, to be treated as having the management of moneys payable under the policy, within the meaning of the Finance Act, and that they will not be exposed to any penalty if they part with these moneys without requiring evidence of payment of the Estate Duty in respect thereof. This view has, I believe, been adopted by the English Counsel of the Life Offices' Association, and confirmed by the Legacy and Succession Duty Department in London, in a letter which appears in the Insurance Record of 11th October 1895. The Examiner will see, however, that he has adequate proof, (1) that the person effecting the assurance died domiciled abroad, and (2) that the Grant is properly made in accordance with the Law of Domicile of the deceased. If the Grant be in a foreign language it should be accompanied by a certified translation thereof.

* Revenue Act, 1884, § 11.

† Revenue Act, 1889, § 19.

With reference to policies issued under the Married Women's Policies of Assurance Act, 1880, I notice first the case of Schumann,* where the policy was effected by a married man upon his own life for behoof of his wife, and it was held that the policy might be surrendered at any time by the Trustee who held it, with the concurrence of the wife; indeed, Lord Shand expressed the opinion that it might be surrendered without that consent, unless the Assurance Company have notice of any intended breach of trust. Again, in Barras,† observations were made on the case of Schumann to the effect that the Assurance Company would be in safety even to make advances against the policies, in terms of their rules, as such transactions would not necessarily be inconsistent with the trust, and, indeed, might be quite necessary for its protection. Again, in the English case of Cleaver,‡ the Executors of a person who had effected an assurance on his life for the benefit of his wife were held entitled to maintain an action on the policy where the Assured was murdered by the wife, and the trust created by the policy lapsed by reason of her crime, from which (just as we saw in considering the suicide clause) she was not entitled to take any benefit. It was held that the assurance money formed part of the estate of the Assured, and, as between his legal representatives and the Company, no question of public policy arose to afford a defence to the action. In this case, the Assured was James Maybrick, husband of the notorious Mrs. Maybrick, and the claimants of the policy moneys were (1) the Assignee of the wife; (2) the Administrator of the wife, and (3) the Executors of the Assured, James Maybrick. The Company was placed in the curious position (1) that, if no Assignation had been granted, it would not have been bound to pay to the wife, because she could take no benefit from her crime; (2) that it was not bound to pay to her Assignee or Administrator, because he could be in no better position than the wife, from whom he derived his title; and (3) it maintained that it was not bound to

Married Women's Policies of Assurance Act.

Surrender.

Advances.

Murder by Beneficiary.

* Schumann *v.* Scottish Widows' Fund, 1886, 13 R. 678.

† Barras *v.* Scottish Widows' Fund, 1900, 37 S.L.R. 831.

‡ Cleaver *v.* Mutual Reserve Fund Life Association, 1892, 1 Q.B.D. 147.

money for the wife. The Company was held bound to pay to the Executors, however, because, although the latter would have held for the wife, if she had not forfeited her interest, she had done so, and the policy formed part of the Assured's estate. It was pointed out that, while the money would not have formed part of James Maybrick's estate, so long as any object of the Trust remained unperformed, yet when that object failed, as it did, the money belonged to his estate; and as the death was not caused by himself, but by the crime of another, the defence must fail, so far as his Executors were concerned. Again, in Jarvie's Trustee,* a policy was taken out by a husband from the Scottish Provident Institution in favour of Trustees for behoof of his wife and children. The husband retained the custody of the Policy, and subsequently granted a Trust Deed for behoof of his Creditors. An action of Multiplepoinding was raised in name of the Institution to determine whether the Policy belonged to the Trustee for the Creditors or to the Trustees for the wife and children. The former prevailed; and it was held that no right vests in the wife or children until there has been actual or constructive delivery of the policy by the husband taking it out, for, so long as he retains the custody of the policy, it is in his power to alter the destination, so that there is no irrevocable transfer. It was observed incidentally by Lord M'Laren that, where the policy is expressed to be for the benefit of the wife and children, they would share *equally*.

Delivery and Apportionment.

Again, in Stewart,† the Trustee in the bankruptcy of the husband had obtained possession of the policy, and sought to retain it, on the ground that, when Stewart took it out, he was insolvent, and the taking of it out was a fraudulent device, resorted to by the bankrupt to make provision for his wife at the expense of his creditors. It was held that the policy vested in the bankrupt, as Trustee for his wife, from the moment of its being effected. It formed no part of his estate, was not liable to the diligence of his creditors, was not revocable as a donation, and was not reducible on the ground of excess or insolvency—these

Custody.

* Jarvie's Trustee *v.* Jarvie's Trustees, 1887, 14 R. 411.

† Stewart *v.* Hodge, February 1901, Court of Session, unreported (Lord Stormonth Darling).

being all statutory consequences of the policy being taken out as it was. If the policy were kept alive and the wife predeceased her husband, the Trustee in bankruptcy might become entitled to the proceeds, but it was his right, and not the wife's, that was truly contingent. The Trustee's statutory remedy for the fraud which he alleged was, not to be put in possession of the policy, but to claim repayment of the premiums paid with intent to defraud, from the Trustee of the policy out of the proceeds thereof, when it came to be realised, but that remedy afforded no answer to the demand for delivery of the policy to its proper custodier. Again, in Kennedy's Trustees,* it was held that the expression "married man" in the second section of the Act includes a widower, and that the trust constituted by a policy taken out by a widower for the benefit of the children of his first marriage vested in the Executors of the Assured, and not in his Testamentary Trustees, the latter not having been specially appointed to deal with the policy. Here the poor man was not only married, but married twice, and yet it was alleged that he was not a married man within the Act. It was argued, therefore, for the widow of the second marriage, that the Trust for the children of the first was ineffectual; that the sum assured was accordingly part of the deceased's estate; and that she (who had herself entered into a second marriage) was entitled to one-third thereof, as *jus relictæ*; but her contention was not sustained.

Widower.

Extinction of Contract.

Discharge.

Lastly, we come to the Discharge of the policy, but, as our consideration of questions of legal title has to some extent involved this point, and, as the form of discharge generally presents no difficulty, little remains to be said. Let me only add, therefore, that where there are two or more claims to the policy moneys, founded upon separate and hostile grounds, the Company can secure an effectual discharge by the action of

(1) **Multiplepoinding.** Multiplepoinding, in which they will lodge a statement of the fund in their hands, called "the fund *in medio*"; consign the amount in bank, in name of the Clerk of Court, to abide the orders of the Court; and obtain a

* Kennedy's Trustees *v.* Sharpe, 1895, 33 S.L.R. 89.

missions in connection with it. The Company will be found entitled to the expenses of bringing the action, and will then retire out of Court as quickly as possible. The effect of the Decree of Exoneration is to relieve the Company of all responsibility, even if the fund be paid to the wrong creditor, in the absence of one who has a better claim; but, of course, the Company should see that all creditors whose claims are known to it are cited in the action. One word as to the origin of the term "Multiplepoinding" before we leave it, because I know it has many terrors, particularly for our English friends. A poinding in our Scotch law is a process by which a debtor's effects may be attached for debt, and the original idea of the action of Multiplepoinding was to benefit the holder of a fund belonging to a third party, called the Common Debtor, by suspending "multiple" or double poindings thereof at the instance of two or more claimants of the fund.

(2) Stamp. That the receipt endorsed on the policy should bear a penny stamp, in respect that the exemption conferred by Sub-section 11 of the Act of 1891, *voce* "Receipt," is considered not to extend to a receipt endorsed on an assurance policy for the sum payable thereunder.

(3) Expense. That the practice of Scotch Companies seems to vary considerably with regard to charging the expense of the final Discharge of the policy against the policy-holder. The question arises where the policy has been dealt with by way of Assignation or Diligence; and, in these circumstances, it was formerly considered that the professional rule contained in the Table of Fees adopted by the legal bodies in Edinburgh and Glasgow regulated the matter, by providing that the expense should be paid by the policy-holder. Some Offices adopted this rule, others did not; but in an opinion given by the present Solicitor-General (Mr. Scott Dickson) in 1892, it was pointed out that, where the policy is payable, as it usually is, to "Heirs, Executors, Administrators, and Assigns," the parties must be held to have contemplated that the policy might be assigned; that a simple receipt would be a sufficient discharge; and that the holder of the policy was not bound to give more, or at least, if the Company wished a formal Discharge, they were not entitled to make the policy-

holder pay for it. He was further of opinion that the terms of the Table of Fees could not affect the question, as it could not impose on a client any further liability than the law would otherwise put on him. A similar decision was given in the case of Muir's Trustees,* and I may add that the new Table of Fees, which came into force on 1st January 1899, does not repeat the provision which the old Table contained, with regard to the expense of the discharge of policies.

When I began this paper, I had intended to add to it a few notes regarding Fire Insurance, but, as it grew under my hands, I found that, in the short time at our disposal, it was impossible to deal with both subjects. I am aware that my notes upon even the one are far from complete, and there are many points that I should have liked to go into, if time had permitted, such as questions regarding Lost Policies, Agency, Excepted Risks, Representations, Warranties, and the like. This has not been possible, and, as my paper has already grown to inordinate length, I submit it to you, without further comment, in the hope that, with all its defects, it may be of practical assistance in the disposal of at least some "Daily Questions of Legal Title."

WARREN CROSBIE, B.L.

Insurance and Actuarial Society of Glasgow,
1901.

* Muir's Trustees *v.* The Alliance Assurance Company, 1895, Sheriff Court, Edinburgh (unreported).

APPENDIX.

NOTES ON STAMP-DUTIES.

The References in Italics are to the foregoing Notes.

	Duty. £	s.	d.
Affidavit or Statutory Declaration	0	2	6
Assignation, absolute. *See* "Conveyance on Sale."			
Assignation, in security. *See* "Mortgage."			
Assumption and Conveyance, Deed of, for appointment of new Trustee	1	0	0

NOTE.—To attract the charge, the Trustee must be a new Trustee, and, accordingly, the appointment of a Trustee under the Second Section of The Married Women's Policies of Assurance Act is not chargeable, unless the deed containing it is liable to deed duty, or unless the Policy has become a claim, prior to the appointment.

Conveyance or Transfer on Sale, absolute Assignation, &c. Where the consideration is—

(1) Price	5s. per £50
(2) Price and relief of loan granted by a third person (not the Assurance Company). Here the duty is calculated on the price, plus the loan, thus:—Price £100, Loan £400, total consideration £500, Stamp at 5s. per £50 = £2 10s. Where the loan is granted by the Assurance Company upon its own Policy, the amount thereof is *not* taken into account in calculating the duty.	5s. ,, ,,
(3) For certain good and onerous causes and considerations .. .. .. *See page* 345.	.. 10s.
(4) Love, Favour, and Affection .. .. *See page* 345.	.. 10s.

NOTES.—(*a*) Where Assignations, however numerous, are necessary links in the Assignee's title, all must be duly stamped; but where there have been Assignations from and back again to the original Assured or any Assignee, the Claimant does not claim under these Assignations, because they simply record a transaction which is completed and closed. He claims under his original title, as Policy-holder or Assignee, and the sufficiency of the Stamp duty on the subsequent deeds does not come into question.

(*b*) Where a Bondholder's Security extends over several Policies, and he consents to the Assignation of one of them by his debtor to a third person, without any sum being paid to the Bondholder in reduction of his loan, so that the Bond is not discharged to any extent, but only a portion of the security is released, the deed is only charged with the Assignation stamp, nothing being charged in respect of the Policy being released from the Security.

Declaration of Trust of any property, by any writing other than a Will or Settlement .. .. .. 10s.

NOTE.—An Instrument containing a mere statement by the persons holding certain property, that they hold it on trust, is liable to duty under this head, and not under "Settlement." To attract Settlement duty, the Instrument must contain the trust purposes for which the property is held.

Factory and Commission .. .. 10s.

Guarantee or Indemnity (without clause consenting to registration) for purpose to which no duty is appropriated by Act—*e.g.*, against loss through payment of Policy moneys, without production of certain deed .. .. 6d.

Mortgage, Bond and Assignation in Security, &c. 2s. 6d. per cent.

(1) Assignation of Mortgage, &c. .. .. 6d. „ „

NOTES.—(*a*) Where the Assignation carries arrears of interest, the duty is calculated, not only upon the principal sum, but also upon the arrears assigned; but if the Assignation be granted, say, between Whitsunday and Martinmas 1900, and carries interest from Whitsunday 1900 (the interest being payable half-yearly), the duty is calculated only upon the principal sum assigned, because the interest not being due until Martinmas, is not truly in "arrear," although partly accrued.

(*b*) Where several Bonds are assigned or disponed in favour of one person, the duty is charged on the *cumulo* amount, and not upon each Bond, where this might involve more than the *cumulo* duty. Where, however, the Assignation is granted to several persons for their respective interests, a separate duty is chargeable in respect of each interest.

(2) Discharge, &c. .. .. 6d. per cent.

NOTE.—Each Partial Discharge of a Bond must be impressed with 6d. per cent. of the total sum secured, if the duty so fixed do not exceed 10s. If it exceed that sum, then 10s. is the duty for each Partial Discharge until the final one, which must be impressed with 6d. per cent. on the whole amount of the original Bond.

Notarially Certified Copy of any Document .. .. 1s.

Power of Attorney .. .. 10s.

Receipt in respect of Claim or Surrender, endorsed on Policy .. .. 1d.

tration .. .. 10s.

" (2) Without do. do. .. 6d.

NOTE.—A Guarantee by one Company to another, in respect of an Annuity purchased from the latter, is regarded by the Revenue as chargeable with 2s. 6d. per £5, under head of "Bond, Covenant," &c.

Settlement, whereby any certain principal sum, stock, or security is settled or agreed to be settled—

For every £100 or part of £100 of the amount or value of the property settled or agreed to be settled .. .. 5s.

NOTES.—(*a*) The Act contains no definition of "Settlement," but it may be taken, generally speaking, to denote a deed between living persons, by which any property is "settled," or directed to be held for certain specified purposes.

(*b*) Where a Policy of Assurance is included in a Settlement, and provision is made for keeping it up, the duty is charged on the amount payable under the Policy, and an accrued bonus forms part of the dutiable amount. Where there is no such provision, the duty is charged on the value of the Policy at the date of the Instrument.

(*c*) *See* Note under "Declaration of Trust" above.

Trust Deed for behoof of Creditors .. .. 10s.

WORKMEN'S COMPENSATION.

I BELIEVE it is the usual course when reading a paper upon the Workmen's Compensation Act, 1897, to hover for a considerable period upon the brink of the main subject by giving a review of the law before that important statute came into force. With your permission, I propose to depart from that time-honoured custom, and at once take up the subject of my paper. I have divided it into three heads:—

(1) The Workmen's Compensation Act, 1897, and the effect of the legal decisions thereon.

(2) A consideration of the effect of the Act upon Accident Insurance Companies.

(3) A suggestion as to what future legislation will probably bring forth.

I do not intend dealing with the subject in a technical manner, and, with regard to the first heading, will simply state as plainly as I can the knowledge we have of the Act. I shall always refer to the Workmen's Compensation Act, 1897, simply as "The Act."

Undertaker. The Act has altered both the name and the status of the party liable to pay workmen compensation for accidental injury received during employment. We have always understood that the employer of a workman was liable to pay such compensation, but now this is altered, and the undertaker of the work alone is liable. According to Section 7, Sub-section 2, of the Act, Undertakers are defined as follows:—Railway companies, mine owners, any person undertaking the construction, alteration, or repair of an engineering work, any person undertaking the construction, repair, or demolition of a building, and in the case of a factory, quarry, or laundry means the occupier thereof, by which is understood the person having the actual use and occupation thereof. An undertaker is not only liable for the workmen he directly employs, but he is also liable to pay compensation to the workmen employed by any sub-

The learned editor of *Arnould*—that well-known text-book, Arnould's *Marine Insurance*—in some very interesting criticisms on a certain judgment, advances the argument that the particular phraseology, the legal interpretation of which he is criticising, became part of the policy in or about the year 1450. The quaint language in question, as he shows by extracts from contemporary writings, was in popular use between 1430 and 1455, and its absence from writings not within that period, as the editor affirms, certainly tends to support him. I have already mentioned the clause in which it is agreed, "that this writing, or policy of assurance, shall be of as much force and effect as the surest writing or policy of assurance heretofore made in Lombard Street or the Royal Exchange, or elsewhere in London." In this curious declaration, the editor of *Arnould* suggests that we may trace the feelings of jealous rivalry then existing between English underwriters and the foreigners of Lombard Street. We have seen that the mob sacked some of the Lombard Street houses in 1455, so that the suggestion may well be something more than merely ingenious. The wording of the policy has been long out of harmony with the requirements, but no attempt has ever been made to alter it, and perhaps none ever will be made. The fact is, there is hardly a phrase—I might almost say hardly a word—in the ancient document which has not at one time or another been the subject of legal argument and decision. The original idiom and phraseology remain therefore in all their antique quaintness. The ship herself is referred to as the "body" of the "good ship or vessel," with her "tackle, apparel, ordnance, munition, artillery, boat and other furniture," whilst amongst the risks insured against are "pirates, rovers, thieves, jettisons, letters of mart and countermart, surprisals, takings at sea, arrests, restraints, and detainments of all kings, princes, and people of what nation, condition, or quality soever; barratry of the master and mariners, and all other perils, losses, and misfortunes that have or shall come to the hurt, detriment, or damage" of the property insured. The list of risks insured against must not, however, be accepted too literally. For example, in agreeing to insure against thieves, it might without extravagance be supposed that the underwriters contemplated insuring against theft. When, however, it speaks of thieves the policy does not mean *thieves*, but *robbers*. You may feel inclined to urge that in any case it does not matter much, seeing that, as I

"*all* . . . perils, losses and misfortunes." But when the good old instrument promises to insure against "all" perils, losses, and misfortunes, it does not mean it a bit; any more than when it promises to insure against thieves, it means to cover loss by theft. "Clearly," says the law in effect, "the framers could not mean to insure literally against any and every risk; you must place some reasonable limit on the phrase." "What limit," you inquire, "and where place it?" "Well," says the law, "this is a policy primarily against the perils of the seas. The 'all other perils' following after the perils specially mentioned, means 'all other perils' of *the like kind*." And, applying this logical test to the phraseology, "thieves" is to be understood not in its wide and general sense, but in the sense of its context. "Pirates, rovers, thieves," runs the wording, The thieves contemplated are, therefore, not petty pilferers, but robbers with violence—robbers of the nature of the just-previously mentioned pirates and rovers. And so on all through the policy: hardly a word that has not had its meaning legally assigned to it. In fact, nearly every line of the policy has become a sort of row of literary hat-pegs to be capped by legal decisions. The venerable instrument is, in short, nowadays to be regarded rather as an index to the law of Marine Insurance as laid down by the Courts, than as of itself the intelligent expression of a contract. But, all contradictory and incoherent as it seems, it is the proved master-key to every Marine Insurance lock, be the lock as complicated as it may. True, like the lock of Doubting Castle, of which old Bunyan tells us, it sometimes goes "damnable stiff"; and the Judges themselves do not always agree which way it is to be turned. But that, no doubt, is the fault of the Judges, and not of the lock.

And now, gentlemen, having by slow, but I trust not unduly tedious steps, brought you up to the sacred portals of that great modern temple of scientific gambling, the system of Marine Insurance, let me invite you to step inside, and with due veneration view the high priest—the underwriter—engaged in the mysteries of his calling. But stay! Let me first ask you to visit with me a shrine which, hiding itself modestly up a blind alley off Cornhill, is, in the importance of its relations to maritime affairs, little less notable than Lloyd's itself. I refer to the home of "Lloyd's Register of British and Foreign Shipping."

"Lloyd's Register" or "The Book."

of *Lloyd's Register*, and most of my hearers, I suppose further, share the common impression that it is part of the work or system of Lloyd's. Lloyd's Register of British and Foreign Shipping is, however, a society entirely separate from Lloyd's. It stands by itself, and is managed by a committee of shipowners, underwriters, and experts in shipbuilding. It has expert surveyors—who are quite distinct from Lloyd's Agents—all over the world. The society lays down rules according to which ships must be built, and failing the strictest compliance with these rules no ship can obtain classification in the Register. Ships, to be so classed, must be constructed under the supervision of the Book's surveyors. When they meet with an accident, in whatever part of the world, they must be repaired under the supervision of the Book's surveyors, and at certain periods of time they must be docked, opened up, and again surveyed, if they are to retain their class. The Register is an alphabetical list of the classed shipping of the world. It is a marvel of detailed, accurate, and up-to-date information which in the course of time has grown to an astonishing point of development. From a small book it has developed into two bulky volumes, one for ships, another for steamers. Every subscriber receives two sets of these books, one of which he keeps at his elbow, while the other remains at the office of the Register. Each set is kept continually posted with the latest alterations, every few days the Register Office sending out the altered copies and taking in exchange the other set to be similarly dealt with. Whatever may have been the case in the days of the ancient coffee-house, the underwriter of to-day without *Lloyd's Register* would be like a carpenter without his rule. *Lloyd's Register* and *Lloyd's List* are in fact the underwriter's bag of tools.

"Lloyd's List."

I have already mentioned that in 1811 a new departure was taken at Lloyd's. It was decided to appoint agents all over the world. Their duty was to be twofold: to keep the Corporation regularly informed of all sailings, arrivals, and casualties reported to them, and to advise and assist captains and the owners of sea-damaged property. Information from these sleepless agents is poured into Lloyd's day and night in a never-ceasing stream. During the day it is posted up in "the Room," and sent round to the various Insurance Com-

together in a printed sheet known as *Lloyd's List*. This list is printed once again in a weekly alphabetical form, and with this beside him an underwriter is able to trace at a moment the voyage, position, and latest news of every ship. If *Lloyd's Register* is his carpenter's rule, *Lloyd's List* is his hammer and saw, and, indeed, as I have said, the rest of his tool-bag.

Having now examined his equipment we can the better inspect our underwriter at his work at the acceptance of risks.

Acceptance of Risks.

If, however, *Lloyd's Register* and *Lloyd's List* are the underwriter's tools, none the less he must know how to use them. To be able to use them profitably he requires years of training and experience, and, even more important, a natural aptitude, without which, sooner or later, he will demonstrate his unfitness. *Lloyd's Register* may tell him all about a particular ship, but the underwriter needs to know something of the quality, reputation, and luck of her owners, of her captain, and of his experience of the voyage to be taken. He must know of the dangers to be apprehended at this or that port, having regard to the qualifications and experience of the ship and the captain; he must know of stormy seasons, probability of ice, draught of water on bars. He must know which cargo is prone to shift if not properly stowed, to catch fire, or to sustain sea-damage. He must know the risks of inland and river transit, the effect of sea-water damage to articles of merchandise as compared one with another, and the degree of honesty, or the reverse, to be counted on at this or that foreign port in the event of damage, real or imaginary. He must have all these things at his fingers' ends, and know his geography as well as he knows the national anthem, and perhaps a good deal better. It is an imposing list of requirements, but long use and, especially, aptitude reduce it all to a sort of instinct. And not only must this instinct be possessed, but there must also be acquired with it a nice appreciation of the value of individual risks. Experience in the sister isle goes to show, I believe, that a trifling loss on the sale of separate apples will grow into profit in the mass if only the sales be large and frequent. The experiment seems not unfrequently to be tried in underwriting, but I have not yet heard of a case in which it has proved successful.

The Risks Insured Against.

I said at the beginning that Marine Insurance, so-called, is really a portmanteau insurance. The marine policy is a sort of Procrustean instrument which any kind of insurance can be made to fit. Until within recent years the Lloyd's underwriters of catholic tendencies as regards the acceptance of premiums always used one and the same document, the old marine policy, to insure against twins, the loss of gate-money, the enterprising burglar, fire, or what not. It is interesting to observe a somew at analogous system of adaptation in the case of the navvy's iron water-bucket, which we may sometimes see with holes punched in it in order to render it serviceable as a portable stove. Now, however, that fire and burglary risks have come to be so frequently covered in "the Room," special and more or less hybrid forms of policy have been invented to suit the case. But risks such as those mentioned hardly come within the accepted scope of Marine Insurance, as commonly understood and practised, though it is, I confess, difficult to say in what manner some of the risks which are usual are less grotesque if applied to the marine policy-form, than risks such as those just indicated. It is common, for example, to insure tobacco and tea from the time of picking till arrival, including the risks of fire and storm whilst drying and till on board. Wool is insured from the sheep's back to the mills, and for aught I know there may be found enterprising experimentalists to cover it whilst it still forms a natural covering to the sheep. Frozen meat is insured against all and every sort of taint, damage, or deterioration from the moment of slaughter until in refrigerated store at destination, including the risk of fire and of breakdown of machinery throughout. Ships' engines and machinery are covered against latent defect, or damage occasioned by the carelessness or neglect of engineers. But if the offer of a risk on a cargo of frozen meat by steamer from the Antipodes would have made the ancient underwriter rub his eyes, there were risks with which he was doubtless familiar which would be little less amazing to his modern successor. Let me illustrate this by quoting from an ancient work on commercial law, printed at The Three Daggers in Fleet Street in 1707, and now in the library of the Inner Temple. "*Assurances*," declares the writer, "may be made on Goods sent by Land, so likewise on Hoys, and the like, and may be made on the Heads of Men; as if a man is going for the *Streights*, and perhaps is in some fear that he may be taken by the *Moors* or *Turkish* Pirates, and so made a slave, for the

Premio accordingly upon a Policy of *Assurance;* and if there be a Caption, the Assurers must answer the Ransom that is secured to be paid on the Policy." Times have indeed changed!

In addition to insuring the ship and her machinery the policy is made to protect the owners against liabilities to third parties consequent on negligent navigation. Such claims are in fact both numerous and heavy. For example, the ship insured runs into another vessel and both sink, with the result that the underwriters, in addition to paying a total loss on the ship insured, may have to pay not much less for compensation due to the other ship and cargo. And always be it remembered the same old policy-form is used, the particular effect required being produced by clauses written in or plastered on the policy; or, more likely, both written in and plastered on. The modern policy, indeed, is apt to be as much clauses as policy; a sort of documentary hoarding for the display of contractual notices. It is just this large and varied use of clauses which makes it so difficult or even dangerous to generalise as to the meaning of the marine policy as such.

Before leaving the subject of the policy and the risks it covers there is one point on which, I think, I should say a few words. I refer to what is known as the F.P.A., or "Free of Particular Average" clause. Particular average is average—*i.e.*, partial loss, damage, or charges—attaching to the interest insured, specially or particularly, and not to the whole adventure generally. Some goods are obviously more prone to damage than others, and insurances to cover average upon—*i.e.*, damage to—such goods are naturally effected at a higher rate, sometimes a very much higher rate, than in the case of goods which sea water damages but little. Consequently, insurances may be divided broadly into these two classes, insurances F.P.A., and insurances to cover average. I have already referred to Marine Insurance as a form of scientific gambling, but in the case of the F.P.A. policy science is dropped, and purely sporting conditions are introduced. The policy is free of particular average "unless the ship be stranded." If the goods arrive heavily sea-damaged and the ship shall not have been stranded it is the merchant who loses, and has to bear the damage. If, however, the ship shall have been stranded—*i.e.*, have rested on the ground for a few minutes or, naturally, longer—then it is the underwriter who has to bear the damage. Whether the stranding shall have *caused* the damage is beside the question altogether—that

ninety per cent. solely by reason of leakage and heavy weather, and yet if the ship shall hang on the dock sill for a brief space on her arrival, causing no damage whatever, then the loss is shifted from the merchant to the underwriter. I doubt whether the humours of the Fire Insurance policy can show us anything so sporting as this.

This reference to the familiar conditions, "Warranted free from particular average unless the ship be stranded," suggests to me the propriety of a few observations on the subject of Warranties generally.

Warranties and Guaranties.

In every Marine Insurance policy there are certain warranties, some of which are implied and some expressed. The former, the implied warranties, are these: that the ship is seaworthy at the commencement of the risk; that the voyage shall be prosecuted according to usage; that the adventure shall be legal; and that the ship shall be properly documented. The risk is accepted on the faith of these conditions, and the policy is rendered null and void by their breach. As regards seaworthiness, however, I should explain that this curious exception attaches to it, that it applies only to insurances on cargoes and on ships for the voyage, and not to insurances on ships for a period of time. As most steamers are nowadays insured for a term of twelve calendar months from a certain date and hour ordinarily "beginning and ending with Greenwich mean time," the importance of the exception will be manifest. The old theory is that as such an insurance may take up when the ship is in a distant port, or even in mid-ocean, it would be unreasonable to expect a guarantee of her seaworthiness; the underwriter ought to fix his premium and take his chance. And so strictly is this principle acted upon, that if the ship be, say, in London or Bristol, her home port, at the commencement of the risk, and sail thence in an unseaworthy condition, unknown to her owner, and be lost in consequence of perils of the seas operating on her unseaworthiness, the underwriter will still be liable. If, however, the owner be privy to such a condition of the ship, her underwriter will be absolved. On the other warranties which are implied I need not here enlarge. I will, however, offer a few remarks on the warranties which are expressed. It is, perhaps, rather misleading to speak of them generally as warranties at all in the sense in which the word is alone used. They are very largely

and are called warranties from the form in which they are expressed. Let me give you an illustration. We have already seen that the policy makes the underwriter liable for losses caused by "takings at sea and arrests restraints and detainments of all kings, princes, and people." Now, in times of peace there is nothing in it: the risk is practically non-existent. But, as we know full well, war may break out at any time, and the underwriter may quite possibly, under the wording of the policy, wake up some fine morning to discover himself liable for, or exposed to, heavy losses in respect of which he has not charged or received a penny premium. There is therefore embodied in every policy—it is a comparatively modern addition—a countervailing clause known as the "Free of Capture and Seizure" clause, or more generally as the "F. C. & S." clause, in which the underwriter expressly warrants himself free from captures, seizures and detentions, and all consequences of hostilities, "anything herein before contained to the contrary notwithstanding." In times of peace this protective warranty is cancelled, as a rule free of additional premium. When war is afoot or the political outlook is dark it is cancelled only against special payment. It is unfortunate, though perhaps only in keeping with the wording of the policy as a whole, that warranties are occasionally so expressed as to encourage a belief, on the part of persons not technically well-informed, that it is they themselves and not the underwriters who are "warranted free." And indeed what with the policy first expressly covering risks of capture, and then setting out a curiously worded clause in big type or red ink in just the opposite sense, which clause is sometimes left in and sometimes struck out, there is certainly room for a little misapprehension. By the other printed warranties the underwriter is held free from claims for damage unless amounting to a stipulated minimum percentage, or unless the ship be stranded; and so forth. Of written warranties for particular cases there is no end; warranted to sail on or before or after a certain date, warranted not to go to certain ports, warranted not to carry certain cargoes, and so on and so forth. Broadly stated, anything expressed to be done by the ship or not to be done is known as a "warranty," and to break a warranty may mean and generally does mean, legally viewed, the invalidation of the policy altogether.

Looking at the subject from a Fire Insurance point of view I dare say you would be surprised at how much a ship may do with-

that the broad distinction between French law and British law is this—that the French law tells you what you may do, the British law what you may not do. Please do not think me unduly narrow-minded or prejudiced if I suggest that there seems to be a somewhat similar analogy between the fire policy and the marine policy. If an underwriter insures a ship and says nothing to the contrary, the ship may carry a full cargo of gunpowder or dynamite, or her machinery may be taken out, replaced, or altered; she may be made to swarm with reckless shipwrights handling blazing gas jets; or the captain may even go to the dangerous length of fitting up a stove in his cabin or putting in electric light without the underwriter having the right to utter a word of protest. I hardly like to declare such things before a Fire Insurance audience, but the fact, outrageous as it may seem, is as I have stated. That it is also a fact from which underwriters derive much profit, I am, however, not in a position to affirm. But, bad as to the Fire Insurance conscience such a state of affairs may seem, even worse remains to be told.

Valuation and Indemnity.

I refer to the question of values for insurance. Now, I believe that the Fire Insurance theory is that the owner of property destroyed by fire must on no account receive more than he is entitled to on the facts; he must never make a profit out of it. Marine Insurance people give themselves no trouble on such a detail as this. The owner of ship or cargo fixes beforehand the value for which he shall insure, and on a loss happening the underwriter pays without a murmur, though, of course, if he prefers to murmur there is no law to the contrary. The law allows a man, for example, who is sending goods to a distant market to form his own conclusions as to what their value should be on arrival, and for this value he insures. It is usual to add, say, 10 per cent. to invoice cost for estimated profit, but 15 per cent. or 20 per cent. are by no means infrequent additions. So long, in fact, as the addition is not very grossly—absurdly—exaggerated, or no obvious mistake has been made, the underwriter has to pay the full amount insured. If the value be very grossly or absurdly exaggerated, then probably the insurance will be held to be null and void—not, however, because of the excessive valuation, but because the fact of such an insurance is mate-

the contract. The essence of the insurance contract, both Marine and Fire, is *bona fides*. Reserves or economies of the truth are severely dealt with where such a contract is concerned, however they may be regarded in matters less mundane. In fixing a value for Marine Insurance, however, a great latitude is allowed. The case of the *Company of African Merchants* v. *Harper*, tried in 1872, is a convenient illustration. In that case the underwriters had to pay the full sum of £11,000 insured, though the cargo actually on board when the loss occurred was only worth £3500. The text-writer's note (the text-writer in question is Mr. Charles McArthur, M.P.; for a bird's-eye and remarkably able view of the "Contract of Marine Insurance," no better book can be got than his valuable and handy work under that title)—the text-writer's note, I say, is this:—"This was an African cargo, and African cargoes vary so much in value that it is difficult to fix the valuation beforehand." So the loser of property worth £3500 was paid the full £11,000 insured. Fire Insurance text-writers, I notice, enunciate the principle that in the case of Marine Insurance the value is that at the commencement of the risk. The conclusion I have come to, after seeing such statements in Fire Insurance works, is that the Marine Insurance expert who decides to hand himself down to posterity as a text-writer may be wise to resist any temptation to unfold himself on the subject of Fire Insurance law. This, however, by the way. To return to the subject of valuation: while the underwriter is liable up to the full sum insured, that is not the limit of his liability. For instance, he insures a ship which puts into a port in distress. He is at once liable for the repairs effected at the port, and if the vessel should be subsequently lost he would have to pay still the full sum insured. I remember, myself, paying considerably more than 100 per cent. on the policy, though the ship eventually arrived. She had put into several ports and incurred various salvage charges. If she had been lost, after all, the settlements would have amounted to more than 200 per cent.

Honour Policies. An honour policy is a policy which is bad in law: which cannot be sued upon in a court of justice. The law against wager-insurances provides that all policies containing such clauses as "policy proof of interest," "without benefit of salvage" and the like, shall be

which is so much waste paper in the eye of the law, has heretofore been regarded as one of the safest Marine Insurance policies a man can hold. In putting his name to an honour policy an underwriter understands that he is contracting not legally but with his honour as the security; and the circumstances in which such an insurance will be repudiated or questioned have hitherto been of exceedingly rare occurrence. Honour policies are common incidents of Marine Insurance business, but they are not usually asked for or granted unless in exceptional and well-understood conditions in which legal proofs of interest would be difficult or inconvenient or are unusual.

General Average. If this paper were to come to a conclusion with the subject which we have just been considering, a Marine Insurance expert, reading it, would be amazed. "Why," he would exclaim, "from first to last there is not a word in it about general average! And a person," he would declare, "who can write a paper on Marine Insurance without mentioning general average might be expected to write on the navigation of the Channel without referring to the Goodwin Sands—to write a history of London in the reign of Charles II. without saying a word about the Plague or the Fire." In order that I may not expose myself to such an obvious criticism, let me once more begin at the beginning; let me take you back to the times when London was a collection of mud-walled dwellings, and butterflies flitted from flower to flower on the grassy plain which has now made way for those same Goodwin Sands. I must take you back, in fact, to the very birth of maritime commerce, when, in all probability, even bottomry insurances were unknown. General average, we may say, was Marine Insurance in its chrysalis form. And the following, no doubt, was its origin: In those remote days referred to, when a sudden storm threatened the safety of the barque, or when she ran upon a rock or bank, there would be a hasty and alarmed conference on the part of the merchant adventurers, the master and his shipmen. There was only one way out of it, the master would exclaim: Somebody's cargo must be heaved overboard—jettisoned—to lighten the ship. Or, if the ship was on her beam-ends, the mast must be cut away. All would be agreed as to the imminence of the danger and as to the manner in which it should be met, but no one of them would see

fice of his particular property when there was other to choose from. However, it was no time for wrangling, and a hasty agreement would be come to that if, for example, Castor's shipment of bales of rugs or Pollux's jars of wine or honey were jettisoned, everybody else would, on safe arrival, contribute to the loss sustained by Castor or by Pollux according to the value of his own property which had been saved by the sacrifice. Or similarly, if the mast were cut away, Castor and Pollux and the rest of them would similarly contribute to the cost of replacing it. Such voluntary sacrifices or losses were known as "general averages." Average was and still is another word for damage; so that general average meant general damage—a damage or average falling on the various parties to the adventure generally. The distinction, broadly stated, between general average and particular average is this: general average must be voluntarily incurred and be borne by all, whilst particular average arises accidentally and has to be borne by the owner of the particular property so injured. So that, as you will observe, general average was and is a sort of mutual insurance, in virtue of which the voluntarily-caused loss of the one is divided *pro rata* amongst all. It was thus the first form of insurance, and it was very early made a condition of the bill of lading or contract of affreightment under which goods were shipped and carried. By-and-by, when by a flight of genius on the part of some unknown ancient the wider system of Marine Insurance was invented, the system of general contribution became unnecessary, at any rate when all the parties were insured. But Insurance in its early days would be new-fangled and far from universal. Possibly there were those, indeed, who regarded it as a mean and even impious device to cheat the decrees of fate and the gods above. It might be good enough for the struggling trafficker in hides or honey, but altogether beneath the dignity of the merchant adventurer who owned the ship and travelled with half a cargo of dyed garments from Bosreh. Interesting evidence of the survival of such a condition of mind at a much later date is indirectly afforded by the Act of Queen Elizabeth, in 1601, already mentioned. "By means of which policie of assurance," runs the Act, "it comethe to passe that upon the losse or perishinge of any shippe there followethe not the undoinge of any man, but the losse lightethe rather easilie upon many than heavilie upon fewe. . . . whereby all merchantes, *speciallie the younger sorte*, are

allowed to venture more willinglie and more freely." So that the ancient system of general average contribution long continued, and to-day still continues, to go hand in hand with the system of Marine Insurance as we know it. The agreement to pay general average remains part and parcel of the contract of affreightment and finds a recognition in the wording of the marine policy. The universal adoption of Marine Insurance as a system obviously rendered unnecessary the chrysalis form. The merchant whose goods are jettisoned or otherwise sacrificed can and does go straight to his underwriter for compensation and is paid in full. But the old general average system goes on all the same. Collections are made in the ancient fashion, and the underwriter who has paid in full ultimately gets back, through the shipowner, the contributions raked in with infinite labour from the scores or hundreds of shippers or consignees. So that we have two systems of insurance, one within the other, like Chinese puzzle-boxes. Obviously the simple course would be to abolish contribution for general average sacrifices; but ancient usages die very hard. If ships or cargoes were as small to-day as they were in the early days no great harm would be done. But with ships as capacious and cargoes as multifarious and bulky as they have now become, the inconveniences of the ancient and superfluous system are nothing less than colossal. Ships to-day are floating warehouses containing thousands of packages of all sorts of goods, the property of scores or hundreds of different persons, and insured with scores of insurance companies and hundreds of underwriters. Let me assist you to comprehend what it means. The *Oceanic* steamer, as you will remember, is longer than the mammoth *Great Eastern*, and I read that a steamer is presently to be built longer than the *Oceanic*. And no doubt as time goes on the record for size will continually be broken. Without, however, considering the extreme case of a leviathan, let us take an ordinary cargo steamer, say of 4000 tons. Now a steamer of this size will carry 4000 tons cargo; that is to say, at 8 or 10 tons to the goods truck, 400 or 500 truck-loads of cargo; or at, say, 20 trucks to the train, 20 or 25 train-loads of cargo. Taking, say, 6 yards to the truck and 20 trucks to the train, we get as the length of a goods train some 120 yards. So that 4000 tons cargo means not far short of 2 miles of trucks; and 12,000 tons—there are vessels of more than this capacity—about 5 miles, of truck-loads. A fire breaks out on board and water is pumped down amongst the cargo—an act of general average sacri-

damaged packages have to be carefully separated from the sound, and surveyed. This is a very ticklish business. Damage caused by the fire-hose or by water voluntarily admitted, or by rough handling, is general average damage. Damage caused by leaks or accidental shipping of seas is particular average damage. Fire damage is particular average, and general average damage to packages actually on fire is treated as particular average. Each package—thousands of them—has to be carefully examined and a record made of the precise kind of damage, if any, which has been sustained. In order to make sure that all the general average contributions shall eventually be paid, each consignee has to sign a general average bond and pay a deposit before he can get his goods. This deposit is almost invariably considerably in excess of the ultimate liability, sometimes ludicrously so. The sufferers go, as I have said, straight to their underwriters for reimbursement. Stacks—I might, perhaps, say cartloads—of account sales, certificates of damage, sound value, charges, and goodness knows what, have to be sent in to the general average stater, and in one, two, three, or four years, as it may happen, a statement is produced which is perfectly appalling in its size and complications. The charges amount, on the average, to about 12 per cent. as an addition to the claim, including the adjuster's fee, which may be any sum up to a couple of thousand pounds. In some cases the expenses actually exceed the amount of the claim, though this is exceptional. The relation which general average claims bear to all other claims for loss and damage is, I may observe, only about 9 per cent.—not a very serious item. The inconvenience of the system can, however, hardly be overstated, and as vessels get bigger and bigger so will the system become more and more insupportable. Some day—I consider it inevitable—an exasperated shipowner will decide to shake himself free from the whole preposterous system, and it only wants such a lead in order to send it down like a house of cards. Gentlemen, next time you read that a big steamer has put into a port of distress or has arrived with her holds flooded in consequence of a fire, let your sympathies go out to the shipowners, the merchants, and especially to the underwriters. Be thankful that you in your own business are not called upon to know anything about general average. Fire Insurance, it is true, is, by comparison with the hoary antiquity of Marine Insurance, a mere thing of to-day.

methods it is allowed to intrude principles and processes reasonable enough in their day, but which the passage of time and altered conditions have rendered a superfluous encumbrance.

And, here, gentlemen, ends my paper on Marine Insurance: I dare say none too soon. The subject of Marine Insurance, indeed, so far resembles another product of the seas—I refer to that popular fish the haddock—that, like it, it can be rendered remarkably dry under treatment. And seeing that antiquity and dryness are apt to go hand in hand, our subject should in truth contain within itself the elements of dryness in a marked degree. If, therefore, I had thought that it would be to your liking, I could doubtless have submitted to you a paper stiff with technicalities and bristling with more or less captivating legal points. The subject not, however, having hitherto been before you I have thought it better to aim at rendering its first introduction to you interesting if not perhaps technically highly instructive. By so doing, moreover, I might be the more likely to incline you to its better acquaintance. If in this I shall have proved in any degree successful, the fact will be my reward.

DOUGLAS OWEN.

Bristol Insurance Institute,
1899.

THE AIMS AND REWARDS OF AN INSURANCE CAREER.

THE first serious problem that confronts me is that of addressing you suitably at the beginning of our session; I shall best consult your wishes and my own reputation in being reasonably brief. One of the thoughts that have occurred to me in connection with our self-educative work is the query—What are the aims and rewards of Insurance as a profession or calling? In choosing the occupation of Insurance in one or more of its several branches, I take it that we have regarded it, in some measure, in one at least of the following aspects—its remunerativeness, its pleasantness, its dignity. Most probably few of us could at 18 years of age have analysed our views (if we possessed any) upon what was to us the strongest attraction of the occupation we had chosen; to the vision of the majority among us its aspects would be somewhat blended. But at any rate we are certain to have weighed up the attractions as they presented themselves to our minds, and we imagined we did not find them wanting. To this line of thought it may be objected that, having once spent a few years in learning something of a profession, a youth has little choice but to go on—that, in a word, when the period arrives at which the glamour has worn off it is too late to trifle with one's chances in life; but I feel sure that the proportion of men who have had a desire for change is extremely small—no greater than will be found in any profession or business. I am firmly persuaded that, granted the possession of adaptability to time's changes, and some tact and general bonhomie, the business of Insurance offers very wide scope for a prosperous and pleasant career. There is room for the use of the highest self-culture and education which is possible to each of us; in this, I venture to say, will lie the secret, if any there be, of a career at once successful and agreeable.

Whether Insurance may properly be regarded as a profession is a point, I imagine, that has never been definitely settled; it is

open to some discussion at least, but the question may be dismissed in very few sentences, seeing it is for us to treat our occupation as a profession if we will, and if we decide in the affirmative to live up to the decision. This at any rate may be said, that certain professions partake now to a large extent of the character of business occupations—*e.g.*, the legal gentleman whose chief employment may be company-promoting or the financing of speculative builders.

The business element so largely enters now into what were once regarded as pure professions that if Insurance has a distinctly business character it is none the less a professional occupation. Personally, I much prefer to regard Insurance in this light. To take this view seems at once to raise our ideas and aims.

To attain to one of the more exalted positions in the profession may not be possible to all of us, but careers of more or less distinction, short of these higher pinnacles, are within our reach with the help of properly directed effort and ambition. Without some ambition no man need waste time in laboriously following an Insurance career. I fear that it must always be, as regards the lower rungs of the ladder, a laborious occupation. Few positions worth having fall to the lot of those who have put forth no effort to attain position. Looking round at what is taking place in other spheres and professions, we see everywhere a distinct raising of the standard of efficiency and a levelling up of status.

Examinations and probationary service once sufficient to class the examinee as fully qualified no longer hold good, greater stringency in matriculation (if I may use the term), and higher qualifications all round as the test of merit, being the rule. These propositions are so self-evident as to sound almost like platitudes. What relation do they bear to Insurance? Simply that, whether we realise it or not, the same rules will inevitably apply to our own calling. To meet such a condition, we in this age have distinctly increased facilities for the acquisition of cultured knowledge and for attaining scientific efficiency. These facilities are widely spread in both a general and a special sense. One of the special provisions is, I need hardly say, the annual examinations of the Federation of Insurance Institutes, in devising and perfecting which the best expert brains in the profession have devoted much time. The importance of the work done is no doubt under-rated now, or at any rate not sufficiently perceived by many in the Insurance world. Before many years have passed, however, the result of this

Discharge. before leaving this part of my paper, and that is, great care is required when paying compensation to take a good discharge for same. This of course applies more particularly to fatal cases, and it is then always advisable to cause letters of administration to the estate of the deceased to be procured and pay the compensation to such administrator, he signing a discharge on behalf of all the dependants. The receipt can then be registered in the County Court as provided by Section 8 of Schedule 2.

This concludes all I have to say directly upon the Act, and we can now consider Part No. II.

A Consideration of the Effect of the Act upon Accident Insurance Companies.

When the Act came into force there is no doubt it increased the interest felt in Accident Insurance. Many new Accident Companies were started, both Mutual and otherwise, and several Fire and Life Companies started an Accident Department. There was, and is, enormous competition for business, and I presume we shall see again what has happened in the past. When the Employers' Liability Act, 1880, came into force, many Mutual Accident Insurance Companies were formed, and with one solitary exception, I believe, they all felt life was too much for them, and quietly faded out of existence.

Many limited Companies have been formed to transact Accident business during the past twenty years, but they have not all attained success.

These are matters of common knowledge, and require no proof. It is evident, then, that Accident business, including Employers' Liability business, has not been of such an exceedingly profitable nature in the past as would lead one to regard it as an absolutely sure and certain means of amassing wealth. Bearing this in mind, what do we find from the date of the commencement of the Act up to the present time? In July, 1898, employers of labour were most anxious to obtain insurance against their liability, and eagerly approached Insurance Companies. There was, and is, enough workmen's compensation business to reasonably satisfy all Companies transacting it, but, unfortunately, a keen rivalry set in between some of the Companies, and in most cases the rates of premium charged were apparently only regulated by their

had any relation to the estimated ultimate cost of the claims is a matter on which I have no information, but if they had it is not unreasonable to suppose that such estimates must have been furnished by the employers. The premium rates were admittedly cut in 1898, in 1899 they were further reduced, and in 1900 I believe the rates are about one-third of what they were in 1898. To give an instance:—One risk in Dublin was quoted 7/6 per cent. in 1898, in 1899 the rate quoted was 4/ per cent., and this was afterwards reduced to 2/6 per cent.; in July, 1900, the rate was 1/6, and for all that I know the rate of a competitive Office may be 1/ per cent. now. Of course, on the other hand, it may be said that there was no experience to guide the Accident Companies in fixing their rates, but this would be hardly correct, as nearly all Accident Companies have transacted what is termed Joint Insurance for years past. The benefits under that scheme are much less than those provided by the Act, but the rates charged were much higher than are now being obtained to cover the full liability of the employers. Further than this, employers' liability policies are issued now to some trades for the same or even less rates than were charged before the Act came into force. The consequence of all this rate-cutting is that the business appears to be in a state of absolute chaos as far as the premiums are concerned, and it has further had this effect—an employer having a small employers' liability insurance to effect does not go to one Company and arrange to take out a policy. No; he writes to every Company of whose existence he is aware and asks for quotations. When he receives the quotations he compares them and writes to No. 1 Company that No. 2 Company has cut their rate by 3d. per cent., and if they cut the rate of No. 2 they will get the insurance. This system is quite new, and is born of the competition for the business.

I have not spoken to a single man engaged in Employers' Liability business who has told me that in his opinion the current rates are at all adequate. Every one says his Office is declining business wholesale, and the mysterious part of the affair now appears to be which are the Offices taking the business.

At the same time, to deepen the mystery, Accident Offices are with few exceptions, judging from their revenue accounts, making the business pay. I think everyone will admit that the position is most curious. Of course there must be some explanation why

and I think this explanation is to be found in the method of dealing with the claims. Accidents cause injuries which may be divided into three classes:—

(1) Ordinary (lasting less than six months).
(2) Permanent.
(3) Fatal.

In the first instance, when the disablement does not last longer than six months, no very serious claim can be made, but when the disablement is permanent it creates a very serious financial liability. Suppose a workman aged 30 loses his right arm by an accident, and is awarded compensation of 10s. per week, it is not too much to assume under the circumstances that the employer will have to make such payment for the whole term of the injured man's life. Now, in one year the weekly payments would only cost £26, but if the loss be compromised, that is commuted, or as an alternative an estimate made of the cost of commuting such yearly payment, a very different result is obtained. Applying this reasoning to Accident Companies, they must either compromise their claims for permanent disablement, or else pay the weekly compensation, and, if the latter, do they estimate the capital value of such an annuity in the account of the year in which the accident happened causing such permanent disablement? I have used the words "capital value," but for this might be substituted the amount for which the claim could be settled in full. I will not here attempt to lay down any definite rule for estimating the ultimate cost of such permanent claims, as circumstances affect each case, and possibly no single rule could be formulated which would suit all cases. However, with a little care, very correct estimates can be made, and there is no possible doubt that the revenue accounts of Accident Companies should show as far as possible the full present and future cost of all claims, temporary, permanent, or fatal, arising in respect of accidents occurring before or during the year under account.

If the accounts of the Accident Companies be examined it will be found that the amounts reserved for claims under investigation vary in a most remarkable degree from about 33⅓ per cent. of the premium income to nothing at all in some cases. It is in this item of amount reserved for claims under investigation that in my opinion the secret of the continuance of the rate-cutting lies, but

are made with all diffidence. By omitting to estimate or by underestimating the full further cost of all claims in respect of accidents occurring before or during the year under account, the full liability of the Companies in respect of their business may not be disclosed, and the results, therefore, may appear more favourable than they really are. I think a reserve for claims under investigation, amounting to 50 per cent. or 60 per cent. of the premium income, would not be at all remarkable for a Company whose business largely consists of employers' liability business, especially if the permanent claims were allowed to accumulate.

From the foregoing you will no doubt have anticipated my conclusion as to the effect of the Act on Accident Insurance Companies. It has had a most unfavourable effect, and employers' liability business has degenerated to such an extent that it will be some years before it can be raised to a proper paying level. The only people having relation with Accident Companies who are saving money at the present time are employers of labour.

The concluding portion of my paper is:—

A Suggestion as to what future Legislation may bring forth.

I approach this subject with considerable misgivings, remembering that it is wise "never to prophesy unless you know." However, I think we may take it for granted that, seeing the vote of the working classes is the breath of life to a politician, no one will risk ruining his political career by attempting in the future to reduce any benefits which previous legislation may have conferred upon workmen, and I would assume that there is no likelihood of a reduction of the liability of employers of labour. The Government Departments have, I understand, stopped the operation of the Act as regards some of the employees of the Crown, and therefore it would not be unreasonable to assume that the Act has been found unsatisfactory. On the other hand, a supplementary Act has been passed extending the benefits of the Act to agricultural labourers. These two facts seem somewhat contradictory. It may be expected, however, that, having once admitted the principle that certain workmen have a right to compensation for all injuries due to their employment, and not deliberately and wilfully caused by themselves, it will be only a question of time till that principle is extended to embrace all employees. I think that will be a long time, if ever, before

certain Continental States, is introduced into this country, as the British people do not, as a rule, take kindly to legislation of too paternal a character.

In conclusion, I would say that, seeing the national importance now of Insurance to cover the liability of employers, such Insurance being practically a guarantee to the workman that employers will fully meet all just claims, it would not be surprising to find Accident Insurance Companies controlled by laws similar to those governing Life Insurance Companies. In view of the present state of affairs it would, in my opinion, be one of the very best things that could happen both for the public and the Companies.

C. H. FRANKLIN.

Insurance Institute of Ireland,
1900.

THE HISTORY AND PRACTICE OF MARINE INSURANCE.

BETWEEN the three great divisions of insurance—Marine, Fire, and Life—there are, as we all know, wide distinctions. A distinction in principle as between life and the other two; a distinction in range and conditions as between Marine and its foster-child, Fire Insurance. Life Insurance is, in principle, an insurance against a single certainty, there being, in fact, nothing uncertain about the risk except the date of its happening. Fire Insurance is, broadly stated, an insurance against a single possibility, which may or may not accrue—the possibility of injury to fixed objects, caused by or as the result of fire. Marine Insurance, as now practised, is a sort of portmanteau insurance, which covers a wide variety of possibilities—that of fire included—in the way of loss, damage, liability, or expenditure in the case of property at sea and on land, at rest, in transit or afloat, as it may happen. Any one of the risks covered by what, for the sake of giving a label to it, we call the Marine policy, affords ample matter for a treatise in itself. Therefore, an invitation to read a paper on Marine Insurance as a whole leaves the lecturer with a sense of freedom which, however gratifying to his sense of resourcefulness and his ability to summarise, is at the same time somewhat embarrassing. In the emergency the inspiration took me to begin boldly at the beginning. And this the more readily as I understand that the topic of Marine Insurance has not hitherto been treated of at any of your meetings. Subject, therefore, to the minor objection that the history of Marine Insurance has, in fact, like the history of language, no beginning, let me now begin accordingly.

To trace Marine Insurance to its bed-rock it would probably be necessary to find the inception of maritime commerce. This is beyond our power, but we know that in some form or another Marine Insurance was practised by the Romans. There is reason to believe that its earliest form was that of a loan on the security of

ment on the ship's arrival, or to lose both capital and increment in the event of her loss. This sort of insurance is still practised, but we now call it "lending on bottomry." A ship puts into some port with which communications are slow or difficult—say, Port Louis, Mauritius—in distress and in need of repairs. To raise the necessary funds the captain pledges the hull or, in old language, the bottom of his ship. The lender receives a bond, known as a bottomry bond, repayable at the ship's destination on her arrival there, the bond being for the amount lent, plus, say, 20 or 30 per cent. "maritime interest." He sends the bond to his agent at the port to which the ship is bound, and, nowadays, takes out a marine policy to protect his loan in the event of her loss. In old days he had presumably to remain his own underwriter. He charged a high rate of interest and took his chance of losing his capital. This, as I say, was probably the first form of Marine Insurance. Later, most likely in the Middle Ages, when maritime commerce was greatly widened and developed, this simple form of insurance developed with it. About the middle of the thirteenth century—let us call it 1250—as a result of the chronic and sanguinary wars in northern and central Italy arising, naturally, out of differences of religious conviction, the inhabitants of the principal cities of Lombardy were driven forth upon the world. Some of the wealthier of them settled in Flanders, but many found their way to London. London did not in those days take kindly to foreigners, and no exception was made in favour of the Lombards. They had, however, this in their favour—they were rich men and had brought their money with them. By lending at rates of interest which compared favourably with those up to that time exacted, the foreigners made influential friends about the Court. At the same time, by acting as agents for his Holiness the Pope in the sale of pardons and wafer-cakes, and thus greatly adding to the revenues of the Holy See, they obtained powerful support from the Pontiff. Now and then, notwithstanding, the mob attacked the lodgings assigned to the strangers individually. With a view to increased protection the Lombards petitioned the Crown for a piece of land to be allotted to them; and probably by judiciously kissing the hem of the official garment they succeeded in getting allocated to them a marshy and unhealthy strip of vacant ground. Upon this plot they built a double row of fine houses thenceforth known as the Lombards' Street. Whether Pope's Head Alley, at the back of Lombard Street, has any connection with the

tioned, I cannot say. The result of the concession was a further influx of Italians, so that early in the following century we find the Lombards established at Newcastle and at Boston, and even engaging in the business of shipbuilding at Inverness. There is, moreover, reason to believe that the training-banks erected to confine and deepen the channel of the Thames are in no small measure the result of Lombard enterprise. No doubt, as a body, they lent their money on shipping and generally engaged in the business of money-lending and Marine Insurance. At this very day the stereotyped form of the Marine Insurance policy (at which we shall look presently) contains an express provision "that this Writing or Policy of Assurance shall be of as much force and effect as the surest Writing or Policy of Assurance heretofore made in Lombard Street." The Italians certainly were early conversant with the business of Marine Insurance, for a treatise on commerce, written in Florence in 1400, makes reference in several places to insurances between Florence and London. There was, too, a large trade between Italy and Barcelona, and the archives of Barcelona for 1435 make special reference to the insurance of ships and merchandise. The term Assurance itself, as used in its present sense, is earliest found in certain chronicles (believed to be genuine) at Bruges, at that time a very considerable port. The chronicle states that in the year mentioned (viz., 1310) the Court of Flanders agreed to the establishment in Bruges of a Chamber of Assurance in respect of marine risks. An ancient Florentine statute, dated, apparently, 1523, enacts that every description of underwriting must be in prescribed form "as contained in the general and universal policy at present in use," and all insurances were to be written out by an official broker, to be remunerated by a percentage on the sum insured. Up to 1455 the Lombards were still in Lombard Street, but they could hardly have been altogether happy, for we read that in that year the apprentices rose against them and rifled many of their houses. The next day the common people were arming to support the apprentices, and but for the interposition of "certayn sad men" Bow bell was to have started the rising. From that time to 1531 the Lombards, who appear to have deserved a better fate, were the victims of oppressive legislation, and an Act passed in the year mentioned (1531) makes special reference to the "strangers of Italy" or "the merchants of Lombard Street." Probably as, one after the other, the Lombards found the situation insupportable and left, their

Lombard Street and its immediate locality still continued to be the centre of banking and Marine Insurance. Of the actual practice of Marine Insurance business in London up to this time we have little direct knowledge. That it was, however, actively carried on there can be no doubt. A letter written by Sir Thomas Gresham in 1560 to his Hamburg agent instructs him respecting the chartering of certain ships to bring gunpowder—made in Germany—for use of the English Government, and directs him as to the sum to be assured thereon.

The first Act in the English Statutes which deals with the subject of Marine Insurance was passed just 300 years ago, viz., in 43 Eliz., *i.e.*, in 1601. As indirect testimony to the long practice of Marine Insurance the preamble observes that "it has been tyme out of mynde an usage amongste merchantes, both of this realme and of forraine nacyons . . . to have assurance made of their goodes, merchandizes, ships and things adventured, or some parte thereof . . . which course of dealinge is commonly termed a policie of assurance: by means of whiche policie of assurance it cometh to passe that upon the losse or perishinge of any shippe there followethe not the undoinge of any man, but the losse lightethe rather easilie upon many than heavilie upon fewe, whereby all merchantes, speciallie the younger sorte, are allured to venture more willinglie and more freely . . ."—and so forth. And the Act goes on to provide that henceforth it shall be lawful for the Lord Chancellor to establish a Commission for the hearing and determining of causes arising out of policies of assurance. This statute was modelled on the insurance legislation of the Hanseatic League. The new Court met, however, with no favour, and insurance causes, like other property causes, eventually fell to be tried by a court of common law. At the date of the statute referred to, Marine Insurance business appears to have been centred at the Office or Chamber of Assurance. The practice seems in those days to have been general of having such an office. It is alluded to, for example, in the Bruges chronicles, already referred to, in 1310. The insurances were made and registered by sworn brokers and notaries, though merchants had the legal right to do this for themselves if they so pleased. It is to be gathered that part of the brokers' duty was to carry round the policy and obtain subscriptions to it, for which, and the registration, they were doubtless paid by a brokerage. At any rate, if they at all resembled the broker as

this running round for signatures must have meant a good deal. A curious document in the Bodleian Library, dated 1654—probably part of the accounts of some insurance broker—shows that the London underwriters were in those days pretty well dispersed, the residences of the various subscribers enumerated in the document being scattered about the city. This must have been a very inconvenient state of affairs, and a place of meeting at which merchants or bankers willing to subscribe policies could be found assembled must have been a desideratum. And about this very time, viz., in 1652, a first step was taken towards the supply of just such a place of assembly. In that year one Hodges, a Turkish merchant, opened in St. Michael's Alley, Cornhill, just at the back of Lombard Street, a house for the "making and selling of a Turkish liquor called kauffee." This new drink was made from a "decoction of berries," of which friend Hodges was the first importer. The new drink became very popular, with the result that other coffee-houses, as they were called, were soon set up. Amongst these, later on, was the coffee-house of one Edward Lloyd. The first mention of it occurs in 1688. Lloyd's coffee-house—whether because it was kept by a Welshman, or because of the superior quality of his "kauffee," or perhaps of other beverages less fragrant but more potent—became specially popular. Shipowning merchants made it their rendezvous in such sort that it grew into a kind of shipping exchange. Ships were put up to auction, captured prizes and their cargoes were advertised for sale there, and the enterprising proprietor even started a chronicle of sailings, arrivals, losses, and captures, which was known as *Lloyd's News*. Situated as it first was in Tower Street, close to the waterside and shipping, it was natural that the frequenters of the house should consist largely of shipping men; and as shipping and Marine Insurance go hand in hand, it was no less natural that underwriters should gather at the same place. About the year 1691 Lloyd moved his coffee-house from Tower Street to a building at the corner of Abchurch Lane and Lombard Street, where it became more widely known than before. The *London Gazette* and the few other contemporary newspapers contain constant mention of it as a place of sales and business meetings, and of payment of reward for tidings of runaway slaves and servants. Ship captains' servants, for whom the sea had no lasting attractions, were the frequent cause of advertisement. Thus we read that "A negro maid, aged about sixteen years, named Bess, having on a

and having lost a piece of her left ear," had run away from her indulgent master, Captain Benjamin Qulch, and was badly wanted by that ill-used son of the sea. Pock-holes, as they were called, were, it may be parenthetically observed, in those days a frequent incident in the description of persons "wanted." Such an aid to identification has long disappeared, but thanks to the thoughtful care of Parliament it will apparently be no great while before it will once more play a useful part in questions of personal discovery or recognition. In 1771 the frequenters of Lloyd's coffee-house became too numerous for their then premises, and it was decided to provide more suitable accommodation Ultimately the coffee-house was established in the Royal Exchange, "under," as we read, "the supervision of the present head waiter." In 1779 the policy-form to be used by the members was discussed, and a printed form was adopted, the form now used by all British underwriters.

Those of my hearers who would like to know more of the history of Lloyd's, of its frequenters and its uses, and of its final evolution into the grand and beneficent corporation of which to-day every Britisher is proud and every foreigner eulogistic; those, I say, who wish to know all about Lloyd's that books can tell them, cannot do better than turn to Martin's *History of Lloyd's and Marine Insurance*, to which interesting work I tender my acknowledgments.

Until 1718 the underwriters known collectively as "Lloyd's" had it all their own way. In that year, however, a movement was set on foot to establish a chartered Marine Insurance Company. Great was the commotion at Lloyd's. To quote Ingoldsby:—

> Alarm was ne'er caused more strong and indigenous
> By cats amongst rats or a hawk in a pigeon-house.

The members lost no time in petitioning Parliament against the revolutionary scheme, and it is interesting to read that in these—more or less—unselfish efforts the underwriters of Bristol were prompt to range themselves on the side of their London brethren. Whether the Bristol records have ever been searched for any documents bearing on Marine Insurance as anciently practised, I do not know. If not, an investigation of the city archives might not impossibly have interesting results. To return, however, to our subject. In spite of all opposition there were in 1720 incorporated two Insurance Companies, the London and the Royal Exchange.

turned out to benefit it. Not only were they found a convenience by underwriters themselves, but they gave to London such a preponderating influence in Marine Insurance that risks were sent to London from the Continent; and there was business enough and to spare for all. In addition, the position of Lloyd's was made securer than ever, for the charter to the new companies was, so far as other contemplated undertakings of the kind were concerned, in the nature of a monopoly. Lloyd's considered that they had no further fear of competition, and the institution prospered greatly. In 1811 an important body of new rules and regulations was drawn up, including provision for the appointment of agents in Great Britain and elsewhere; and a secretary—to whom, however, the advantage of a preliminary training as a head waiter was no longer deemed indispensable—was for the first time made part of the system. Up till 1810 no attempt was made to break down the monopoly granted to the two chartered companies. Such an endeavour was, however, in that year made, but unsuccessfully, and matters remained as they were till 1824. At that date the great and in the City all-powerful Nathan Rothschild, gathering round him Sir Moses Montefiore, Samuel Gurney, and a few other men of leading influence, succeeded in getting through Parliament a Bill to authorise the establishment of a new Insurance Company to be known as the Alliance British and Foreign Fire and Life Assurance Company, with a capital of five millions sterling. It is a big sum, even to-day, but three-quarters of a century ago it must have seemed positively staggering. Having issued their prospectus, constituted their company, obtained their Act of Parliament, and commenced business, the directors decided to enter also upon Marine Insurance business. There stood in the way, however, the old Act which prohibited to co-partneries (other, that is, than the two chartered companies) the business of Marine Insurance. The directors therefore set themselves to work to obtain the repeal of this Act, and in this they succeeded in the month of June. Arrangements to combine Marine Insurance with the Company's other business were thereupon completed, and on September 1 the new departure took place. A few months previously, however, a Marine Insurance Company pure and simple had been placed on the stocks in view of the probable repeal of the ancient Act already mentioned. This company was the Indemnity. Naturally such a turn of affairs was highly unpalatable to Lloyd's, and means were

Indemnity Company, which had started solely as a Marine Insurance Company, was unassailable, but a weak spot having been discovered in the Alliance Company's armour, the most was made of it. One Natusch, a Lloyd's man, a shareholder in the Alliance, applied to the Court for an injunction to restrain the Alliance Company from engaging in business not contemplated by their prospectus, and the injunction was promptly granted, though not until the Company had been underwriting for a few months. Mr. Rothschild and his friends, however, declined to sit down under this victory of Lloyd's, and at once proceeded to form a new company for Marine Insurance business—the Alliance Marine Insurance Company. It was arranged that the shareholders in the old Company should be, so far as they wished, the shareholders in the new; that Mr. Rothschild should underwrite in his own name pending the legal formation of the new Company; and that on its formation the Company should take over the business written by Mr. Rothschild as well as the business written by the old Company before the injunction. The old prohibitive Act having been promptly repealed, the Indemnity Marine Insurance Company and the Alliance Marine Insurance Company—then, and ever since, with a Rothschild at its head—at once became legal competitors with Lloyd's underwriters and the two chartered companies. The repeal of the old Act was the letting of the wind into the wood. he Alliance and the Indemnity were followed in a few years by the Marine Company, and many others succeeded them. Of these latter some remain, some have been bought up, some, I apprehend, burst up.

This, gentlemen, is the history of Marine Insurance so far as I am able to at the same time trace and summarise it. At the commencement maritime commerce and Marine Insurance no doubt went hand in hand, and it is certain that for several centuries past this has been their relationship. Commerce, I dare say, could, without Marine Insurance, have struggled along; but that without Marine Insurance it could ever have attained to its present enormous development it is difficult to believe. And not only has Marine Insurance been a blessing in itself, but as the parent of all other kinds of Insurance it has played a leading part, both commercially and socially, in the history of the world's moral development. To take only a recent illustration—the Workmen's Compensation Act. Founded as it is on the well-recognised possibilities of Insurance,

would, in the general estimation, have been to deal a blow at the national industries generally, and at private enterprise in particular. The uses of Insurance have, as we know, during the past few decades made extraordinary advances in all sorts of directions, and yet its development has been so unostentatious that we find ourselves to-day accepting it all quite as a matter of course. When the domestic history of the nineteenth century comes to be written, there will be, if I mistake not, few of its most notable features which will be found to exceed in importance the various new and beneficent applications of the principles of Insurance, guarantee, and indemnification. But not having been invited here to sing of the greatness and goodness of Marine Insurance, or of the virtues and beauty of its numerous offspring, let me claim your attention for a space on the subject of that hoary and incoherent instrument, the Marine Insurance Policy.

The Marine Policy.

When or by whom the policy of Marine Insurance was first composed we are entirely without information. In the most ancient statute of Florence, dated 1523, it is provided that every description of underwriting must be effected after a prescribed form, "as contained in the universal policy at present in use." It is probable that it was this "universal policy" which the Lombards employed when they came to England, where, indeed, they are likely to have found it already in use. Amongst the literary treasures of the Bodleian Library at Oxford is a policy—in English—dated February 15, 1613. Possibly there may be there, or elsewhere—amongst the Bristol archives, for example—a still more ancient specimen, but so far no older has been discovered. It is not the original document, but apparently a copy made for purposes of litigation. The blessings or otherwise of litigation as applied to the marine policy are, indeed, unfortunately not altogether of modern discovery. Probably the Oxford specimen is identical with the "universal policy" mentioned in the Florentine statute of 1523. For all practical purposes the form agreed upon at the meeting of Lloyd's underwriters in 1779 is identical with the Bodleian copy dated 1613, so that, without any great stretch of the imagination, I think we may take it that the marine policy-form in British use to-day is in the main the same ancient form which is referred to in the Florentine statute of 1523 as the "general and universal

storeys and attic; extinguishing appliances: buckets to scale. (*b*) Two Doubling Mills, of two storeys and four storeys respectively, each containing 10,000 spindles, communicating together openly.

10. Write out, fully, the specification wording for Machinery and Stock. Under what circumstances are these items to be made subject to average?

11. Draw three diagrams to illustrate arrangement of Blowing, etc., Rooms, which do not render the Mill subject to additional charge for processes previous to Carding.

12. What are the requirements applicable to Blowing and Mixing Rooms rated at 36s., Class II.?

SUBJECT No. 8—BOOT AND SHOE TARIFF.

(One hour and a half allowed.)

QUESTIONS.

1. To what Buildings does the Boot and Shoe Tariff apply?

2. Quote the provisions as to Average and state the items of the Factory Specification affected.

3. Detail particulars of the rule in respect of adjoining Buildings.

4. How do the rules as to Agencies and Commission read? Quote them.

5. How is the distinction between the different normal Factory rates defined and specified? Give the terms.

6. What is the additional Tenancy charge?

7. Write out the Drying and Conditioning Warranty, and name the extra chargeable when such Warranty is not observed.

8. What are the Provisions in connection with the use of:—

(*a*) Cement or Rubber Solution;

(*b*) The making of Shoemaker's wax or dubbin, the application of Waterproofing solution, and the employment of Benzoline, Naphtha, or other spirit or substance containing rubber;

(*c*) The warming of Shoemaker's wax.

9. Quote the Assistants' Clause.

10. What are the Regulations as to Fireproof Factories?

11. Give particulars of the discount allowances for approved Automatic Sprinkler Installations supported by other Extinguishing Appliances.

12. Detail in full the items of the Factory Specification, omitting reference to the condition about which a question is asked in Query No. 2 above.

(One hour allowed.)

QUESTIONS.

1. What Risks are rateable under this Tariff?

2. What would be the Tariff Rate (and show how it is made up) on a Building of four storeys, brick and slated, used for manufacture of Earthenware, having two ovens, four pipe stoves, with over three feet of pipe to each; Steam drying rooms, Packing inside; oil used for presses, and lighted by oil lamps?

3. What improvements would you suggest to the Firm whereby the rating could be reduced, and to what extent?

4. What is the Tariff Rate on a detached Packing House, brick built, with timber roof; lighted by an oil lamp?

5. In the case of a Packing House forming part of a Works in which all the buildings communicate, what alterations would you suggest which would enable the Packing House to remain, but would reduce the rate over the Works? State what the reduction in rate would be.

6. What is the Tariff Rate for a Flint Grinding Mill?

7. Also the Tariff Rate for a Glass Bottle Works—non-fireproof?

8. State the rate on a Brick Works, brick and partly timber built; lighted by oil lamps; heated by fire flues.

9. Suggest improvements whereby the rate could be reduced, and state difference in rating?

SUBJECT No. 10—POLICY DRAFTING (COTTON MILLS—ENGLAND AND IRELAND).

(Time: One hour and a half.)

DESCRIPTION.

1. Five Storeys. Mill, Fireproof throughout. 1st, Carding, Preparing, and Roving, communicating with Blowing Room by a fireproof passage, 10 feet long, having an I.D. at each end. 2nd, 3rd, 4th, and 5th, Mule Spinning.

2. Five Storeys. Fireproof throughout. 1st, Blowing Room; 2nd, Mixing Room, containing a bale breaker (no beater) delivering cotton into room, and two bale breakers (with beaters), cotton being drawn therefrom by exhaust through incombustible tube direct into opener in first storey; and metal spout, 10 feet long, with an iron lid at top and bottom, to first storey; 3rd, Cotton in Bale Store and Bale Opening. Cotton is fed by hand direct from the bale through iron traps to second storey. No loose cotton. 4th and 5th, with No. 1.

3. Two Storeys. 1st, Yarn and Oil Store; 2nd, Mill Furnishing Store.

Buildings S. or B. and S. Spinning lower than 80 hanks to the pound. Heated and worked by steam and lighted by gas. Not containing more than 20,000 spindles in any one fireproof floor.

Fire extinguishing appliances equivalent to 10 per cent.

Rates.

No. 1. 1st, 2nd, 3rd, and 4th Storeys, 7/6. 5th, 8/6 (Normal, 7/6; Ht., 1/-); Roof, 2/6 nett.

No. 2. 1st, 7/6 Building and M.Wk.; 36/- Machinery, and 46/- Stock. 2nd, 7/6 Building and M.Wk.; 16/- (Normal, 15/-; Spout, 1/-) Machinery, and 26/- Stock. 3rd, 7/6 Building and M.Wk.; 12/- (Normal, 10/-; openings, 2/-) Machinery and Stock.

No. 3, 2/6 nett.

All rates subject to 10 per cent., except those marked nett.

Proposal.

	Building.	Millwright's work.	Machinery.	Stock.
1. Mill. 1st to 5th Storeys, in equal proportions	£10,000	£5,000	£5,000	£5,000
Roof	1,000	—	—	—
2. 1st	300	100	800	200
2nd	300	50	200	3,500
3rd	300	100	20	Cotton in Bale only. 3,500
3.	1,000	100	100	100

The items to which average applies are to be so marked, and warranties applicable to be given. You are required to draft a Policy on the foregoing particulars, and calculate the annual premium.

SUBJECT No. 11—POLICY DRAFTING (BOOT AND SHOE FACTORIES).

(Time: One hour allowed.)

Messrs. Smith & Hudson, of Portland Square, Bristol, Boot and Shoe Manufacturers.

B.S.S.T. communicating buildings (wood lined in places), 1, 2, and 3 floors (certain openings through these) and attic in height; lighted by gas and heated by low pressure hot-water apparatus, occupied as Factory (Gas Engine used for power), employing 200 hands. Situate as above.

Building	£3,000
Machinery	4,000
Gas Engine	200
Stock	6,800
	£14,000

Draft a Policy. Fix Rate and show Analysis. Use Printed Tariff Warranties. Quote Annual Premium.

SUBJECT No. 12—POLICY DRAFTING (POTTERIES TARIFF).

(One hour allowed.)

Questions.

1. Proposal is received from Messrs. John Jones & Son, Earthenware Manufacturers, Hanley, for £5000 on Building and Contents of Works, brick and slated, all communicating. What separate sums would you require before preparing Policy?

2. Give rough draft of wording for the Policy, with rating, allowing Steam Boiler fired inside, Packing inside, steam drying, and oil lamps for use in filling Ovens.

3. Draft a wording, insuring Building of a detached Lavatory, one storey, brick and slated, situate on the Works, for £500, and state the rate you would charge.

4. Draft wording and rate for a Building of two storeys, brick and slated, and part timber built (forming part of a Brick Works), occupied as Boiler House; and Drying Shed, heated partly by exhaust steam and partly by flues, with Mill over; one pipe stove free of woodwork; lighted partly by gas and partly by oil lamps.

5. Draft wording and rate for Building, brick and slated, and part timber built, two storeys, ordinary wood floors and stairs, used as Glass Works, containing usual Furnaces, communicating, and also three pipe stoves for warmth, secure; lighted by oil lamps.

SUBJECT No. 13 — LAW OF FIRE INSURANCE (POLICY CONDITIONS, AVERAGE, INSURABLE INTEREST, LOSS APPORTIONMENTS).

(Time: Two hours and a half.)

QUESTIONS.

1. What is the legal definition of "Fire Insurance"?

2. What are the leading principles on which a contract of insurance is founded?

3. What, in general terms, is an insurable interest? Give examples of some of the more remote interests.

4. What are the various circumstances under the usual conditions of the Policy which are sufficient to render it void, or forfeit its benefit?

5. What are the conditions which are claimed as being "conditions precedent" to the recovery of any loss under the Policy?

6. What is the effect of express warranties on a Policy?

7. What are the "days of grace" and their advantages to the Insured? and in what cases are these allowed and not allowed?

8. In the case of loss, on what principle is the measure of damage assessed?

(*a*) On goods belonging to a Manufacturer.
(*b*) In the hands of Dealers.
(*c*) In the case of Farming Stock.

9. Under what Act were Insurance Offices required to reinstate buildings damaged or destroyed by fire? and on what grounds was this done, and under what limitations?

10. What is the effect of each of the two Conditions of Average?

11. Where insured property has been burnt by the negligence (short of wilful negligence which might constitute an act of felony) of an Insured or his servants, what is the effect as respects:—

(*a*) His right of claim against his insurer.
(*b*) His liability to other persons who may suffer through his fire.

12. Apportion the following losses:—

	£	s.	d.	£	s.	d.
(I.) Office A insures on Dwelling-house and Stable		...		600	0	0
Office B insures on Dwelling-house		...		300	0	0
Loss on Dwelling-house	300	0	0			
,, Stable	300	0	0			
	£600	0	0	900	0	0

(II.) Office A insures on Dwelling-house and Stable				600	0	0
Office B iusures Dwelling-house				300	0	0
Office C insures Stable ...				300	0	0
Loss on Dwelling-house	750	0	0			
,, Stable	300	0	0			
	£1,050	0	0	1,200	0	0

SUBJECT No. 15—CORRESPONDENCE (FIRE BRANCH).

(Two hours allowed for this Paper.)

Questions.

1. Write to a promising Agent who offers an ineligible Waste Store, and threatens to resign his Agency in the event of an unfavourable response. He mentions that two Proposals already sent in by him and declined, have been freely accepted by other first-class Offices.

2. Write in reply to an Agent who complains that an Insurance for six months is charged three-fourths of the annual rate, and that a Farm Produce Policy, dated from 1st September to 28th February, is charged the full annual rate.

3. Write a full reply to a Policy-holder (a Draper) who advises that he is compelled by the Factory Inspector to erect a stove in his large workroom, which already contains a small fire-place at each end.

4. Write in reply to a Proposer who affirms that he ought to be specially treated because he never insures to the full value of his property, and is therefore specially interested in guarding against a fire, and that nearly all fires are the outcome of excessive insurance.

5. A Policy-holder, in acknowledging a cheque for £10 in settlement of his claim for damage to furniture insured for £150, points out that if it had not been for the strenuous exertions of himself and some members of his family in promptly extinguishing the fire, it is very probable that serious damage would have resulted, and he concludes it is as little as the Company can do to award them a handsome donation. Reply thereto.

6. Notify a Policy-holder (who has had a suspicious fire) that his Insurance cannot be renewed on the ensuing Quarter Day. Also state how you would reply if he enquires the reason for discontinuance.

SUBJECT No. 16—CORRESPONDENCE (LIFE BRANCH).

(Two hours allowed for this Paper.)

1. A Company valuing by the H^m $3\frac{1}{2}$ per cent. Table, and earning £3 15s. 0d. per cent. on its Funds, has for many years declared a uniform Bonus of £1 10s. 0d. per cent. per annum. In 1901, two Valuations are made (1) on the old basis, which would have just permitted the old rate of Bonus, and (2) by the H^m and $H^{m.5}$ 3 per cent. Tables, but the Bonus which can be allotted is only 15/ per cent. The latter is adopted.

Draft a Circular announcing these changes to the Agents of the Company.

2. A professional man, aged 30, proposes to spend about £100 a year in Insurance. Write him a letter of advice. State what assumptions you have made as regards his family ties and responsibilities.

Rates, with Profits:—Whole Life, £2 8 0;	Endowment Assurance at 45,	£6 12 6
Discounted Bonus at 25/ per cent. } 1 18 0;	,, ,,	50, 4 18 6
	,, ,,	55, 3 18 6
	,, ,,	60, 3 6 6

Assume that a uniform Bonus of £1 10s. 0d. per cent. per annum will be maintained in the future.

3. An old Insurer under a Non-Profit Policy, writes:—

"I have now paid the Office more in premiums than the amount insured, and I consider that in fairness you should either allot me Profits or permit me to stop paying premiums. With interest, I see you have received from me about three times the sum insured."

Answer this letter.

SUBJECT No. 17—MATHEMATICS.

Questions.

1. Simplify— $\dfrac{\frac{1}{6} \text{ of } \dot{1}}{\frac{1}{9} \text{ of } \dot{6}} \times \dfrac{8{\cdot}5}{{\cdot}085}$

2. How many times can ·0076 be subtracted from 3·45, and what will be the remainder?

3. Calculate (1) banker's discount, and (2) true discount, on £155 14s., due six months hence, at 4 per cent.

4. A stockbroker buys stock for his client, his commission at a quarter per cent. amounting to £11 11s. 3d. How much stock did he buy?

5. The owner of an estate with a gross rental of £2000 per annum, sells it for 30 years' purchase of the gross rental, and invests the proceeds in Egyptian Unified 4 per Cent. Stock at $104\frac{1}{2}$. What amount of stock will he receive, and what will be the difference in his income, assuming that the deductions from the rental of the property for taxes, management, &c., amounted to 15 per cent.?

6. Solve the equations: (*a*) $(2x + 1)(x + 2) = 3x^2 - 4.$
(*b*) $x^2 + 16xy + 3y^2 = 60.$
$7x - 4y = 17.$

7. What number is that from which, if 50 is subtracted, the remainder will be equal to its half together with its fourth and sixth parts?

8. Which is the greater: the arithmetical mean of 1 and $\frac{1}{9}$, or their geometrical mean?

9. Sum to 20 terms the following series: $-9, -7, -5$, &c.

10. The product of three numbers in geometrical progression is 729; and their sum is 39. Find them.

11. How many different permutations can be made of the Letters in the word "Assurance" taken all together?

12. From a group containing three classes, namely, 7 men, 5 women, and 3 children, how many groups of 3 can be arranged having one out of each class?

13. Prove the Binomial Theorem for a positive and integral exponent.

14. Calculate by the Binomial Theorem the cube root of 128 correct to five decimal places.

15. Given log. of 2 = ·30103
" " 3 = ·47712
find the logs. of 5, 9, 12, 27, and 14·4.

16. Find the product of 5976·
·0005976 and
5·976
given that the log. of 59·76 = 1·77641
and that log. 21342· = 4·32923.

SUBJECT No. 18—LIFE ASSURANCE AND LIFE OFFICE WORK.

(Three hours allowed for this Paper.)

QUESTIONS.

1. What is a Table of Mortality? State the columns usually modern Tables?

2. When and from what materials was the Carlisle Table of Mortality constructed? Why is it now superseded by more tabulated in such a Table.

3. Why is the Institute of Actuaries H^m Table not a suitable one for use in calculating rates of premium? What Tables are generally used?

4. To what considerations should special attention be given when framing a Table of Surrender Values for Office use?

5. Describe the "Contribution Method" of Division of Profits.

6. In making selection of an Office in which to insure for the Whole of Life with Profits, mention the principal points which should influence the choice of an intending proposer.

7. What is the object of a Valuation? A prosperous Office has given the same rate of Compound Bonus for some time, and now values by the H^m and $H^{m.5}$ $2\frac{3}{4}$ °/₀ Tables. Why so, when it would be easily solvent at $3\frac{3}{4}$ °/₀ interest?

8. Give the form of Revenue Accounts and the form of Balance Sheet required of Life Assurance Offices under the Life Assurance Companies Act, 1870.

9. Draw up a Statutory Notice that A has mortgaged a Policy to B: state how it should be sent and what steps should be taken by the Office on receipt of this notice.

10. A assigns a Policy to B, and gives notice to the Office. The deed is not stamped: to avoid paying a penalty, B reconveys the Policy to A, who again assigns it to B by a properly stamped deed. How must the Office act when the Policy becomes a claim?

11. Frame an Endorsement to be placed on a Whole Life with Profit Policy, converting it into a Paid-up Policy without Profits. Policy, £1000. Bonuses, £375. Paid-up Policy, £750.

12. Mention the chief improvements in Life Assurance Conditions during the last 30 years.

NAMES OF SUCCESSFUL CANDIDATES.

The following is the Official List of the Successful Candidates at the Examinations, held simultaneously at the various Insurance centres, April 22nd to 30th, 1901. The letter "P" opposite a name signifies Pass, and "H" Honours.

	Chemistry.	Building Construction.	Guarantees.	Processes of Manufacture.			Tariffs.			Policy Drafting.			Law of Fire Insurance.	Correspondence (Fire).	Correspondence (Life).	Mathematics.	Life Assurance
				Cotton.	Boot and Shoe.	Pottery.	Cotton.	Boot and Shoe.	Pottery.	Cotton.	Boot and Shoe.	Pottery.					
Clark, A. B., *Westminster*, Birmingham ...	...	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cooper, N. A., *Norwich Union*, Birmingham	...	...	...	...	P	H	...	...	...	...	...	...	...	...	...	...	...
Cramp, F. C., *Royal Exchange*, Birmingham	...	...	P	...	...	P	...	...	...	...	...	...	...	...	...	...	...
Gibbs, F. C., *Norwich Union*, Birmingham	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...
Holt, J. H. L., *Norwich Union*, Birmingham	...	...	...	...	P	P	...	...	...	...	...	...	...	...	...	...	...
Howlett, L. L., *Kent*, Birmingham	...	...	P	...	P	...	...	...	...	...	...	...	...	...	...	...	...
Jones, A. H., *Royal Exchange*, Birmingham	...	...	...	...	...	...	...	P	...	...	P	...	...	...	...	...	...
Jones, D. S., *Atlas*, Birmingham ...	...	...	...	...	P	H	...	P	H	...	P	H	...	...	...	...	...
Milnes, W. A. *National of Ireland*, Birmingham	...	...	H	..	...	H	...	...	...	...	...	...	P	...	...	...	...

NAMES OF SUCCESSFUL CANDIDATES, 1901—*continued.*

	Chemistry.	Building Construction.	Guarantees.	Processes of Manufacture.			Tariffs.			Policy Drafting.			Law of Fire Insurance.	Correspondence (Fire).	Correspondence (Life).	Mathematics.	Life Assurance.
				Cotton.	Boot and Shoe.	Pottery.	Cotton.	Boot and Shoe.	Pottery.	Cotton.	Boot and Shoe.	Pottery.					
Plummer, N. C., *Northern*, Birmingham	...	...	P	...	...	H	...	...	H	...	...	H	P	...	...	...	...
Robison, R. D., *Royal*, Birmingham	...	...	...	...	P	H	...	H	H	...	P	P	...	P	...	...	...
Turner, H. E., *Scottish Union and National*, Birmingham	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
White, E. G., *Royal*, Birmingham	...	...	...	...	...	H	...	...	H	...	H	H	...	P	...	...	...
*Gibbs, J., *County*, Bristol	...	P	H	...	H	...	...	P	P	...	H	H	...	H	...	...	...
Gillingham, S. J., *Northern*, Bristol	...	...	...	P	H	H	...	...	...	...	...	...	...	...	...	...	...
Jolly, H. S., *Union*, Bristol	...	...	...	...	...	...	...	P	...	...	...	P	...	...	...	...	...
Kepple, R. H. J., *Norwich Union*, Bristol	...	...	...	...	...	...	...	...	...	...	P	P	...	...	...	P	...
Newman, W. H., *County*, Bristol	...	H	...	...	H	...	...	H	H	...	P	...	...	...	...	...	...
Poole, W. H., *Northern*, Bristol	...	...	...	...	P	P	...	...	...	...	P	...	...	...	...	...	...
Smith, A. E., *Edinburgh Life*, Bristol	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...
Blood, H. F., *Liverpool and London and Globe*, Dublin	...	...	...	...	...	...	...	P	...	...	...	...	...	...	P	...	...

Butler, S. P., *Royal*, Dublin				P	P			P			P		H						
Dewar, L. F., *Norwich Union*, Dublin								P				P		P					
Graves, R. H. A., *Alliance*, Dublin														P	P				
M'Gahey, R., *Standard Life*, Dublin															P				
Sparrow, G. F., *London and Lancashire*, Dublin		P																	
Brown, Junior, R. *General Accident* (Perth), Glasgow		P		P	H			H			P	H							
Carmichael, R. H., *Scottish Union and National*, Glasgow					P				H										
Laidlaw, J. H., *North British and Mercantile*, Glasgow					P			H			P								
MacNeill, J., *Liverpool and London and Globe*, Glasgow					H	P		P	H		P	H							
Mackinnon, J. H., *West of Scotland*, Glasgow								P	P		P	P							
Nicol, A. W., *North British and Mercantile*, Glasgow		P																	
Oliphant, J., *West of Scotland*, Glasgow		P						P	H										
Prosser, C. R., *West of Scotland*, Glasgow		P						H			P	P	H						
Schumacher, H., *West of Scotland*, Glasgow		P						H	P		P	P							
Adams, W. E., *British Law*, Leeds, Yorkshire		P												P					
Banks, H., *North British and Mercantile*, Leeds, Yorkshire	P		P								P								
Barbour, A., *Equitable*, Bradford, Yorkshire			H			H			H				P	P					
Bastow, J. A., *Atlas*, Leeds, Yorkshire								P											
Bradford F., *Royal Exchange*, Leeds, Yorkshire		P		P															
Buckley, H. S., *Equitable*, Bradford, Yorkshire													P			P			

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				Cotton.	Boot and Shoe.	Pottery.	Cotton.	Boot and Shoe.	Pottery.	Cotton.	Boot and Shoe.	Pottery.					
*Coates, A. O., *Lion*, Leeds, Yorkshire	...	H	H	...	P	...	...	H	P	...	P	H	...	P	...	...	...
Cooke, H., *Liverpool and London and Globe*, Leeds, Yorkshire	...	...	...	P	H	H	...	...	...	...	...	...	...	P	...	...	...
Dalton, H. E. J., *Lancashire*, Leeds, Yorkshire	...	...	...	P	...	...	P	...	...	...	...	...	...	P	...	...	...
Dodwell, H. M., *Yorkshire*, York, Yorkshire	...	...	...	P	H	...	P	P	H	...	H	H	...	...	...	...	...
*Eckford, J. P., *Royal Exchange*, Leeds, Yorkshire	P	H	P	...	H	H	...	H	P	P	P	P	...	...	...	...	...
Foster, J. W. W., *Liverpool and London and Globe*, Leeds, Yorkshire	...	H	P	H	H	...	...	...	...	...	...	...	...	...	...	...	...
Freeman, S. E., *Sun*, Leeds, Yorkshire	...	P	...	...	...	...	...	H	...	...	...	...	...	P	...	...	...
Gray, H., *Royal Exchange*, Leeds, Yorkshire	...	P	...	...	P	...	...	...	...	...	...	...	...	...	...	...	...
Hitchcock, A. E., *Yorkshire*, York, Yorkshire	...	P	...	...	H	H	...	P	...	...	P	...	H	...	...	...	...
Hodgson, F. E., *Friends Provident*, Dewsbury, Yorkshire	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...
Mallett, F. C., *Atlas*, Leeds, Yorkshire	...	...	...	...	...	...	...	...	...	...	P	...	...	P	P	...	...
Mann, C., *British Law*, Leeds, Yorkshire	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	..	...
Metcalf, W. E., *North British and Mercantile*, Leeds, Yorkshire	...	...	...	P	...	...	...	P	P	...	P	P	...	...	...	...	...

Monkman, P. L., *Yorkshire*, York, Yorkshire	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Needham, E. J., *British Law*, Leeds, Yorkshire	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...
Newport, W. H., *Equitable*, Bradford, Yorkshire	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...
Norminton, B., *Royal*, Leeds, Yorkshire	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...
Oates, F. E., *Westminster*, Leeds, Yorkshire	...	...	...	...	...	...	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...
Purchon, Geo., *Royal*, Leeds, Yorkshire	...	P	...	...	H	...	...	H	...	...	P	...	...	P	...	...	...	...	...	...	...
Read, R., *Westminster*, Bradford, Yorkshire	...	...	...	...	P	...	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...
Simon, H. G. W., *Commercial Union*, Leeds, Yorkshire	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sutcliffe, H. R., *Phœnix*, Leeds, Yorkshire	...	...	P	P	...	...	...	H	P	...	P	H	...	...	...	...	...	...	...	...	...
Turner, G., *Liverpool and London and Globe*, Leeds, Yorkshire	...	H	...	P	H	...	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...
Wood, E. S., *Atlas*, Leeds, Yorkshire	...	...	P	...	P	...	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...
Wood, H. H., *Yorkshire*, York, Yorkshire	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Barnett, R. D., *Commercial Union*, Leicester	...	...	...	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...	...	...	...
Brister, C., *Hand-in-Hand*, Leicester	...	...	...	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...	...	...	...
Lowe, N. D., *Hand-in-Hand*, Leicester	...	...	...	...	H	...	...	P	...	...	...	...	...	...	...	...	P	...	...	...	...
Ruston, R., *Commercial Union*, Leicester	...	...	...	...	...	...	.	H	...	...	P	...	...	P	...	...	...	...	...	...	...
Sharp, W. H., *Hand-in-Hand*, Leicester	P	...	...	...	...	...	...	H	...	...	P	...	...	...	...	...	...	...	...	...	...
Wilson, A. E., *Hand-in-Hand*, Leicester	...	...	...	...	...	...	...	...	...	...	P	P	...	...	...	...	...	...	...	...	...
Mitchell, T. K. O., *Royal*, Liverpool	...	...	...	...	H	...	...	P	...	...	H	...	...	...	...	...	...	...	...	...	...

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				Cotton.	Boot and Shoe.	Pottery.	Cotton.	Boot and Shoe.	Pottery.	Cotton.	Boot and Shoe.	Pottery.					
Sykes, E., *Royal*, Liverpool	...	...	...	...	H	...	...	P	...	...	H	...	...	...	...	...	...
Williams, F. J., *Royal*, Liverpool...	...	...	...	...	P	...	...	P	...	...	P	...	...	...	...	...	...
Winstanley, W., *Royal*, Liverpool	...	...	...	...	H	...	...	P	...	...	P	...	...	...	...	P	...
Amer, R. Q., *Royal*, London	P	...	P	...	...	...	...	...	...	...	...	P	P	P	...	...	...
Blizard, G. P., *Scottish Equitable*, London	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	H
Clayton, A. E., *Royal*, London	H	...	P	...	P	H	...	P	H	...	P	P	...	P	...	..	...
Gerrard, J. G., *Royal*, London	H	...	P	...	H	H	...	P	...	...	P	P	...	...	...	...	...
Hayward, W. H. B., *London and Lancashire*, London	...	...	...	...	...	...	...	P	...	...	...	P	...	...	...	...	...
Healy, L. T., *Royal*, London	P	P	...	P	H	...	...	...	...	...	...	...	H	...	...	...	...
Manton, E. G., *Law Union and Crown*, London	...	...	...	...	H	...	...	P	...	...	...	...	...	H	...	...	...
Marsh, S. J., *Law Fire*, London	H	P	P	...	H	H	...	H	...	...	...	P	...	...	...	...	...
Pringle, H. M., *British Law*, London	...	...	P	...	...	H	...	...	P	...	...	P	P	...	...	...	...
Ridpath, F. W., *London and Lancashire*, London	...	...	...	...	...	...	...	P	...	...	P	P	...	...	...	...	...

Barker, S., *State*, Manchester	...	...	...	...	...	...	...	...	P	P	...	...	P	...	...	P	...	...	...	...	...	...	...
Cawley, A. P., *Northern*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	P	...	...
Collinge, W., *Guardian*, Manchester	...	...	...	...	...	...	...	...	...	P	..	...	H	...	...	H	...	...	...	...	...	...	...
Dean, F., *State*, Manchester	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	P	...	...	...	...	...	...	...
Greenhorne, J. H., *Northern*, Manchester	...	...	...	...	...	...	...	...	...	P	...	...	H	...	...	H	...	...	...	...	...	...	...
Harrison, T. R., *Royal Exchange*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...
Hobbins, A. E., *Guardian*, Manchester	...	...	...	...	...	...	...	P	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...
Hood, G., *Scottish Union and National*, Manchester	...	...	...	...	...	...	...	...	P	P	...	...	...	...	...	P	...	...	...	...	...	...	...
Lowe, P. T., *Royal Exchange*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...
Marriott, G. P., *Norwich Union*, Manchester	...	...	...	...	...	...	...	...	...	H	...	...	H	...	...	P	...	...	...	...	...	...	...
Richards, G. P.. *Equitable*, Manchester	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	P	...	...	...	...	...	...	...
Sharpe, E., *Guardian*, Manchester	...	...	...	...	...	...	...	...	...	P	H	...	P	P	H	H	...	...	...	...	...	...	...
Armstrong, R. P., *Royal Exchange*, Newcastle	...	...	...	...	...	...	...	...	...	...	H	...	...	P	...	...	...	...	...	...	...	...	...
Dykes, E. C., *Union*, Newcastle	...	...	...	...	...	...	...	P	P	...	...	...	...	...	...	...	P	P	...	...	...	...	...
Henderson, G. E., *Royal*, Newcastle	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	P	...	...	...	...	...
Jobling, J. G. R., *Royal Exchange*, Newcastle	...	...	...	...	...	...	...	P	...	...	H	...	...	P	...	...	...	...	...	...	...	...	...
Liddell, W. T., *Royal*, Newcastle	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...	...	...	...	...
Lloyd, T. P., *Northern*, Newcastle	...	...	...	...	...	...	...	H	P	...	H	H	...	...	P	...	...	...	...	...	...	...	...
McDonald, A. G., *Lancashire*, Newcastle	...	...	...	...	...	...	...	...	P	...	P	H	...	P	...	...	...	...	...	...	...	...	...
Patterson, C. A., *Northern*, Newcastle	...	...	...	...	...	...	...	...	...	...	P	H	...	...	...	...	...	...	...	...	...	...	...